IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:	)	Confirmation No.: 1770
	)	
Roy A. Ostgaard, et al.	)	Group Art Unit: 1743
	)	
Serial No. 09/156,952	)	Examiner: Dwayne K. Handy
	)	
Filed: September 18, 1998	)	
	)	
For: **SAMPLE VIAL FOR USE IN PREPARING CYTOLOGICAL SPECIMEN**	)	

SUPPLEMENTAL APPEAL BRIEF-CFR 41.37

Mail Stop Appeal Brief-Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

This Supplemental Appeal Brief is being filed in response to the Notification of Non-Compliant Appeal Brief, dated November 21, 2006, and is in furtherance of the Notice of Appeal, filed September 9, 2006. It contains the following items in the order indicated below as required by C.F.R. §41.37:

I. Real Party in Interest
II. Related Appeals and Interferences
III. Status of Claims
IV. Status of Amendments
V. Summary of Claimed Subject Matter
VI. Grounds of Rejection to be Reviewed on Appeal
VII. Arguments
VIII. Appendix of Claims Involved in the Appeal
IX. Evidence Appendix
X. Related Proceedings Appendix

I. Real Party in Interest

The real party in interest in this appeal is Cytyc Corporation of Boxborough, Massachusetts, a corporation organized and existing under laws of the Commonwealth of Massachusetts.

II. Related Appeals and Interferences

There are no appeals or interferences that will directly affect, or be directly affected by, or have a bearing on the Board's decision in this appeal.

III. Status of Claims

This application includes claims 1-26. Of these claims, claims 1-8, 10, and 12-27 are pending, and the remaining claims 9 and 11 have been cancelled. Of the pending claims, claims 1-8, 10, and 12-27 stand rejected, leaving no claims allowed. The claims on appeal are claims 1-8, 10, and 12-27.

IV. Status of Amendments

All amendments have been entered.

V. Summary of Claimed Subject Matter

Although the invention should not be limited to the preferred embodiments described in the specification, the invention will now be described in terms of one preferred embodiment in order to aid in understanding the invention.

Independent claim 1 (the only independent claim on appeal) is directed to a sample vial 10 for use in an automated test apparatus (see page 8, lines 14-17). The sample vial 10 of claim 1 generally includes a body 12 (see Figs. 1 and 5); a cap 14 releasably engagable with the body

12 (see page 8, lines 17-19; Figs. 1 and 5); and a seal 24 disposed between the body 12 and the cap 14 so as to be capable of forming a substantially fluid-tight seal therebetween (see page 9, line 22 to page 10, line 2 and Fig. 5).

Claim 1 further requires the cap 14 to comprise an outer surface and a torque pattern 38 on the cap outer surface (see page 9, lines 8-9; Fig. 6). In one exemplary embodiment, the torque pattern 38 comprises a plurality of radially disposed ribs 16, thereby allowing the cap 14 to be installed on or released from the body 12 using a rotatable interface that engages the radially disposed ribs 16 (see page 9, lines 9-14; Fig. 6).

Claim 1 further requires the body 12 to comprise an outer surface, an open end, a closed end, and an anti-rotation lug 18 (see page 8, lines 21-23; Fig. 1). The anti-rotation lug 18 has a lowermost surface that is accessible when the cap 14 is engaged with the body 12 for reacting against a proximate structure (bore 52 of interface 54 or bore 62 of vial sleeve 64) of the automated test apparatus when installed therein to facilitate at least one of automated removal and installation of the cap 14 (see page 13, line 12 to page 14, line 13; Figs. 5, 7A, 7B). In the exemplary embodiment, there are six equally-spaced anti-rotation lugs 18.

For example, after the vial 10 has been filled with a sample, the body 12 can be disposed within the bore 52 of the interface 54, with the anti-rotation lugs 18 abutting against the vertical faces 58 of ramps 56 when clockwise rotation of the body 12 is attempted during installation of the cap 14 (see page 13, lines 12-21). In addition, the body 12 can be disposed within the bore 62 of a vial sleeve 64 illustrated in Fig. 7B, with the anti-rotation lugs 18 being received in the slots 66 (see page 13, line 22 to page 14, line 2). Thus, counter-clockwise rotation of the body 12 is prevented when the cap 12 is removed in order to dispense the sample, and clockwise rotation

of the body 12 is prevented when the cap 12 is reinstalled on the body after the sample has been dispensed (see page 14, lines 9-11).

Claim 1 further requires the lowermost surface of the anti-rotation lug 18 to have certain features, which may facilitate proper interaction with the ramps 56 of the unidirectional interface 54 and the slots 66 of the vial sleeve 64. First, the lowermost surface of the anti-rotation lug 18 is generally flat to maximize the area that comes in contact with the vertical face 58 of the respective ramp 56 (see Figs. 5 and 7A). Second, the lowermost surface of the anti-rotation lug 18 extends radially outwardly from the outer surface of the body 12 along a plane perpendicular to the outer surface of the body 12, which ensures that the anti-rotation lugs 18 properly engages the bottom surfaces of the ramps 56 and slots 66 (see Figs. 5 and 7A). Third, lowermost surface of the anti-rotation lug 18 is located closer to the open end than to the closed end of the body 12, thereby allowing the body 12 to be properly inserted within the bore 52 of the interface 54 and the bore 62 of the vial sleeve 64 (see page 8, line 26 to page 9, line 1; Figs. 5, 7A, and 7B).

VI. Grounds of Rejection to be Reviewed on Appeal

Whether claims 1-8, 10, and 12-26 are unpatentable under 35 U.S.C. §103 as being obvious over U.S. Patent No. 5,894,733 ("Brodner") in view of U.S. Patent No. 5,855,289 ("Moore").

VII. Arguments

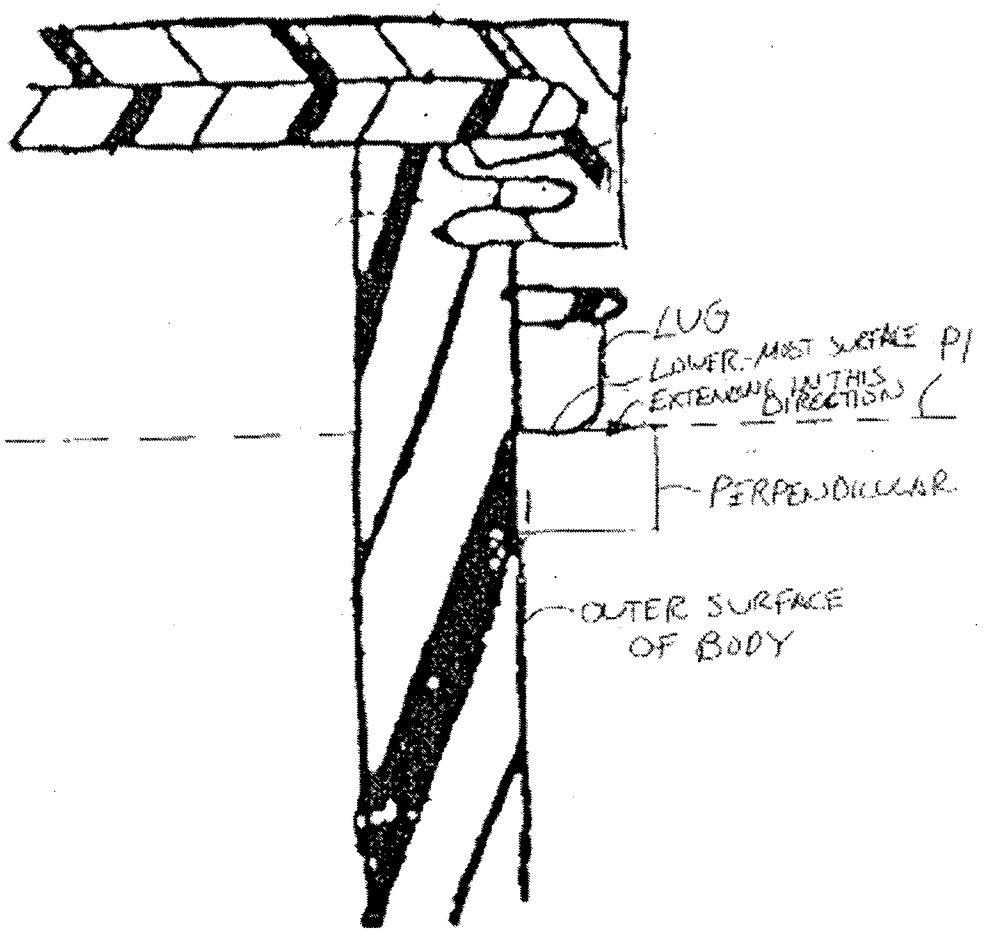
Applicant respectfully submits that the Examiner erred in rejecting claims 1-8, 10, and 12-27 under 35 U.S.C. §103 as being obvious over Brodner in view of Moore. The Examiner indicated that Brodner discloses all of the elements recited by claim 1, with the exception of a torque pattern with a plurality of radially disposed ribs (see Office Action, dated July 14, 2004,

and then used Moore to provide this missing element. Applicant submits, however, that the teachings of Brodner and Moore, even if properly combined, would not result in the claimed invention.

To establish obviousness, it must be found that the differences between the claimed invention and the prior art would have been obvious to a person having ordinary skill in the art. Graham v. John Deere Co., 383 U.S. 1, 17 (1966). Applicants believe that the differences between the claim 1 invention and the teachings of Brodner and Moore would not have been obvious to a person having ordinary skill in the art.

In particular, even assuming that Brodner and Moore can be combined, there is a significant element not disclosed in the resulting vial—i.e., a lug having a generally flat, lower-most surface that extends radially outwardly from the outer body surface of the vial along a plane perpendicular to the body outer surface. Notably, the issue before this Board is not whether it would be obvious to modify the lugs of the Brodner device to include this feature (an issue that was before this Board in the previous appeal), but rather whether the lugs of the Brodner device include this feature at all.

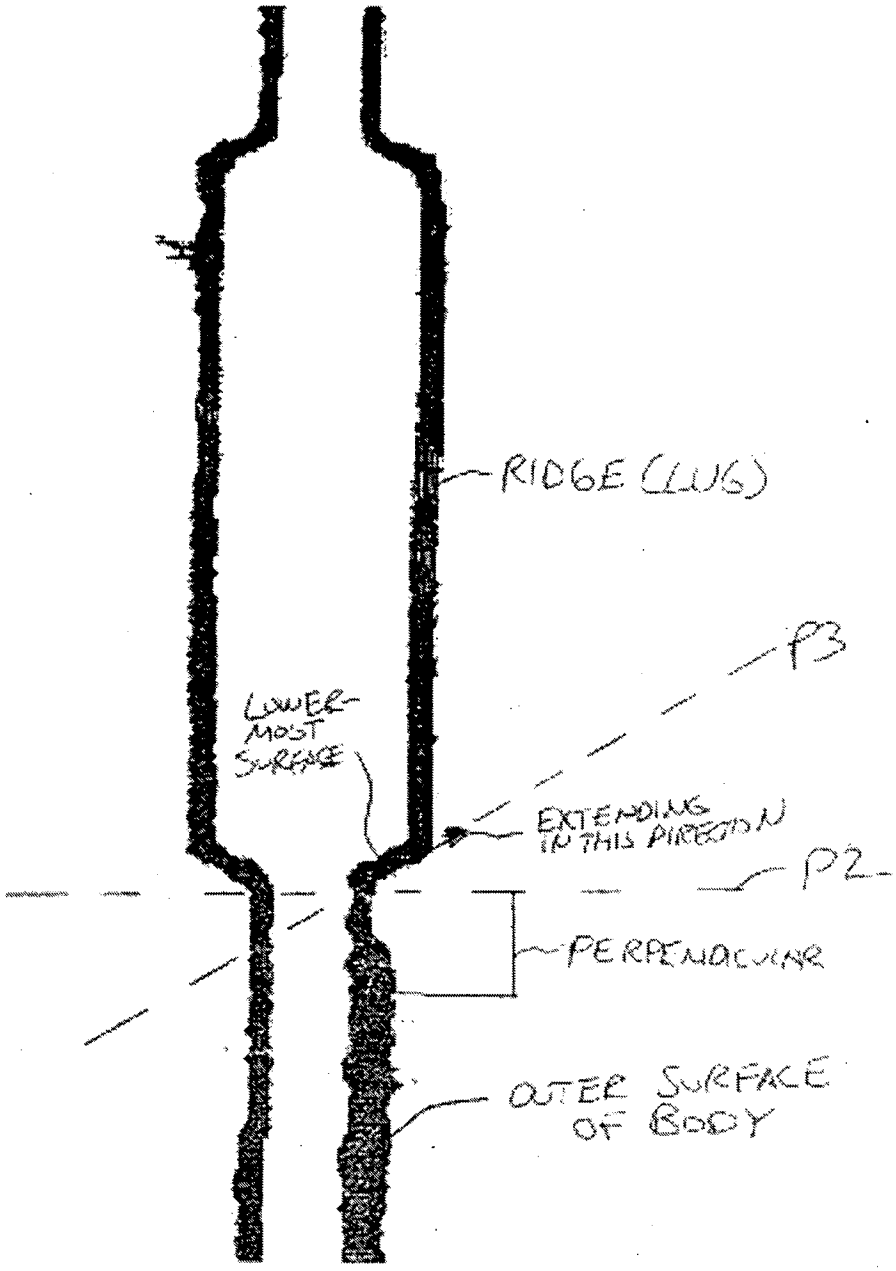
Fig. 5 of the present application is reproduced below to illustrate this claimed feature. As can be seen, a lower-most surface of the lug 18, which is generally flat, extends radially outward from the outer surface of the body 12 of the vial along a plane P1 (along the direction of the arrow) that is perpendicular to the body outer surface.



Brodner, which the Examiner has referred to as disclosing this feature, is directed to a specimen vial 10 and labeled sleeve 12 that, in combination, purport to overcome difficulties apparently associated with labeling containers stored at cryogenic temperatures. (col. 1, lines 7-12, 23-26; Fig. 2). The vial 10 is cylindrically shaped and includes vertically spaced ridges 34 disposed about its exterior surface 30. (col. 2, lines 61-63; Figs. 1, 2, and 4.) (Brodner Figure 2 (left-hand drawing) seemingly misidentifies the ridges 34 by using reference designator 10). The sleeve 12 also includes vertically spaced ridges 58 disposed about its interior surface 52. (col. 3, lines 30-32, Fig. 2). The vial 10 is inserted into sleeve 12, resulting in a "nested engagement," wherein the sleeve ridges 58 are in "pressing engagement" with the vial ridges 34. (col. 3, lines

42-47). The sleeve 12 operates similarly in relation to the tray 16. Specifically, the sleeve 12 includes vertically spaced ridges 56 disposed about its exterior surface 44. (col. 3, lines 28-30). The aperture opening 66 of the tray 16 includes vertically spaced ridges 68 that are in "pressing engagement" with the ridges 56 of the exterior surface 44 of the sleeve 12 when the sleeve 12, with the vial 10 nested therein, is placed in the aperture 62 of the tray. (col. 3, lines 34-41).

Fig. 2 of Brodner, reproduced below, illustrates the ridges 56 of the vial sleeve 12. Even assuming that the ridges 56 can be considered lugs that radially extend outward from the outer surface of a vial, the lower-most surface of each ridge 56 does not extend along a plane P2 that is perpendicular to the outer surface of the so-called vial. Rather, as clearly illustrated in Fig. 2, the lower-most surface of each ridge 56 extends along a plane P3 (in the direction of the arrow) that is angled to the outer surface of the vial.



Despite this clear distinction between the claims and Brodner, the Examiner has maintained that the lower-most surfaces of the Brodner ridges 56 do extend along a plane that is perpendicular to the outer surface of the vial. In particular, the teachings of Brodner were originally characterized by the Examiner as follows:

> Brodner teaches the use of polyprophylene (column 3, lines 11-13) combination 14 sample vial comprising a sleeve 12 and inner container 10. The combination having an outer surface 55, an open end and closed bottom end (Fig. 2). The vial combination comprising a plurality of integral anti-rotation lugs 56 about the outer surface of the cylindrical body (Figs. 2-3). Wherein the anti-rotation lug comprises a flat, longitudinally disposed surface extending radially outwardly from the body outer surface, which is substantially perpendicular to the body of the vial. (page 3 of Office Action, dated July 14, 2004)(emphasis added).

To further clarify the claimed invention, Appellant subsequently amended the claims to require the anti-rotation lug to radially extend outwardly from the body outer surface along a plane perpendicular to the body outer surface. (See Amendment and Response, dated October 13, 2004). Appellant then pointed out that the lower-most surfaces of the ridges 56 are tapered or beveled, and therefore extend radially outward along a plane that appeared to be about 45 degrees to the outer surface of the sleeve structure 12—not a plane that was perpendicular to the outer surface of the sleeve structure 12. (See page 5 of Amendment and Response, dated October 13, 2004).

The Examiner responded by stating that the point at which the ridge 56 extends from the outer surface would qualify as the lower-most surface of the ridge 56 in that the lower-most surface still extends away from the outer surface of the body. (See pages 3-4 of Office Action, dated January 11, 2005). At the request of Appellant to clarify this statement, the Examiner transmitted a marked-up copy of Fig. 2 of Brodner (attached hereto), illustrating how the lower-most surface of the ridge 56 extends along the y-axis out of the page. Without amending the claims, Appellant subsequently argued that the lower-most surface does not extend along in the y-direction out of the page, but rather extends off-axis from the y-axis due to its tapered nature. (See pages 1-2 of Response after Final, dated March 11, 2005).

The Examiner responded, stating:

> Applicant appears to be arguing that the line formed by the tapered edge is not perpendicular to the body surface. The Examiner, however, refers applicant to the claim. The claim recites a lug "comprising a generally flat lower-most surface along a plane perpendicular to said outer body surface." That is, the limitation appears to define the plane in which the lug exists – not the angle that a line formed by the taper (or the taper itself) with the body surface.
>
> The lug forms an element that is in a defined plane once it begins to extend from the body surface. As noted by applicant, the Examiner has referred to this as the y-direction in the diagram. This plane – no matter how much the lug element tapers – is still defined two-dimensionally in this single plane. For example, if one were to draw a line that started at the beginning of the taper and followed the taper (start from the body surface, extending out of the page) to infinity the line would still lie in the same plane of element 62. That plane is the plane extending out of the page. This defined plane is perpendicular to the surface of the body outer surface. This is what the claim requires. (See Advisory Action, dated June 29, 2005).

Admittedly, Appellant unclear as to what the Examiner is referring to. The claim simply requires the lower-most surface of the lug to extend "radially outwardly from said body outer surface along a plane perpendicular to said body outer surface." The Examiner states that this limitation appears to define the plane in which the lug exists. It does not. It defines the plane in which the lower-most surface of the lug exists. That is, the lower-most surface of the lug extends in the plane, as illustrated in Fig. 5 above. The lower-most surface of the Brodner ridge 56 extends in a plane, but this plane is not perpendicular to the outer surface of the body, as illustrated in Fig. 2 above. The Examiner states that if one were to draw a line that started at the beginning of the taper and followed the taper to infinity, the line would still lie in the same plane as the ridge 56. Appellant fails to understand what it means to lie in the same plane as the ridge 56, but clearly, this line does not lie in a plane that is perpendicular to the outer surface of the body, as required by the claims.

Thus, Brodner does not disclose a lug that has a lower-most surface that radially extends outwardly from an outer surface of a vial along a plane that is perpendicular to the outer body

surface, and thus, the differences between the sample vial of claims 1-8, 10, and 12-26 and the teachings of Brodner and Moore would not have been obvious to a person having ordinary skill in the art. As such, Applicants respectfully submit that claims 1-8, 10, and 12-26 are patentable over the prior art of record.

Respectfully submitted,

VISTA IP LAW GROUP LLP

Dated: December 21, 2006

By: _____
Michael J. Bolan
Reg. No. 42,339

Customer Number
41696
PATENT TRADEMARK OFFICE

VISTA IP LAW GROUP LLP
12930 Saratoga Ave., Suite D-2
Saratoga, CA 95070
Phone (408) 777-2902
Fax (408) 877-1662

VIII. Appendix of Claims Involved in the Appeal

1. A sample vial for use in an automated test apparatus, the sample vial comprising:

a body comprising an outer surface, an open end, a closed end, and at lease one anti-rotation lug about said body outer surface, the anti-rotation lug comprising a generally flat, lower-most surface extending radially outwardly from said body outer surface along a plane perpendicular to said body outer surface, the lowermost surface located closer to the open end than to the closed end;

a cap releasably engagable with said body, said cap comprising an outer surface and a torque pattern on said cap outer surface, said torque pattern comprising a plurality of radially disposed ribs; and

a seal disposed between said body and said cap so as to be capable of forming a substantially fluid-tight seal therebetween,

wherein the lower-most surface is accessible when the cap is engaged with the body for reacting against proximate structure of the automated test apparatus when installed therein to facilitate at least one of automated removal and installation of the cap.

2. The sample vial of claim 1 wherein said body comprises a translucent material.

3. The sample vial of claim 1 wherein said body comprises polypropylene.

4. The sample vial of claim 1 wherein said cap further comprises knurling along an outer perimeter thereof.

5. The sample vial of claim 1 wherein said cap comprises polypropylene.

6. The sample vial of claim 1 wherein said seal comprises a multicomposite material.

7. The sample vial of claim 1 wherein a substantially fluid-tight seal between said

body and said cap is formed when between about 5 and 50 inch-pounds of torque is applied.

8. The sample vial of claim 7 wherein a substantially fluid-tight seal between said body and said cap is formed when about 20 inch-pounds of torque is applied.

10. The sample vial of claim 1 wherein said torque pattern comprises six radially disposed equi-spaced ribs.

12. The sample vial of claim 1 wherein said body comprises a plurality of circumferentially-disposed lugs.

13. The sample vial of claim 12 wherein said body comprises six equi-spaced circumferentially-disposed lugs.

14. The sample vial of claim 12 wherein said plurality of circumferentially-disposed lugs are disposed proximate said open end.

15. The sample vial of claim 1 wherein said body further comprises fluid level indicia disposed on said outer surface thereof.

16. The sample vial of claim 15 wherein said fluid level indicia comprises a frosted annular band disposed circumferentially about said body outer surface.

17. The sample vial of claim 15 wherein said fluid level indicia comprises at least one fill line.

18. The sample vial of claim 17 wherein said fluid level indicia comprises an upper fill line and a lower fill line.

19. The sample vial of claim 1 wherein said cap comprises a first alignment marker said body comprises a second alignment marker, wherein said first and second alignment markers indicate a fluid-tight seal when at least aligned.

20. The sample vial of claim 19 wherein said cap may be removed from said body by

the application of less than about 25 inch-pounds of torque, when said first marker is at least aligned with said second marker.

21. The sample vial of claim 1 wherein said seal is disposed within said cap.

22. The sample vial of claim 1 wherein said cap further comprises a first screw thread, said body further comprises a second mating screw thread, said cap and said body being releasably engagable by means of said first screw thread and said second screw thread.

23. The sample vial of claim 1 wherein said body further comprises sample indicia.

24. The sample vial of claim 23 wherein said sample indicia comprises a bar code.

25. The sample vial of claim 1 wherein said body further comprises a flange proximate said open end.

26. The sample vial of claim 1 wherein the proximate structure is selected from the group consisting of a storage tray and a vial sleeve.

27. The sample vial of claim 1 wherein the body is designed to be inseparable.

IX. Evidence Appendix

1. U.S. Patent No. 5,894,733. Originally cited by Examiner in Office Action, dated March 10, 2003.

2. U.S. Patent No. 5,855,289. Originally cited by Examiner in Office Action, dated September 8, 2000.

X. Related Proceedings Appendix

None.

US005894733A

United States Patent [19]

Brodner

[11] **Patent Number: 5,894,733**

[45] **Date of Patent: Apr. 20, 1999**

[54] **CRYOGENIC SPECIMEN CONTAINER AND LABELED SLEEVE COMBINATION AND METHOD OF USING SAME**

[76] Inventor: **John R. Brodner**, 426 Hillside Ave., Glen Ellyn, Ill. 60137

[21] Appl. No.: **09/003,912**

[22] Filed: **Jan. 7, 1998**

[51] **Int. Cl.**[6] **F25B 19/00**; F25D 17/02

[52] **U.S. Cl.** **62/51.1**; 62/64; 62/457.9

[58] **Field of Search** 62/51.1, 64, 78, 62/457.9

[56] **References Cited**

U.S. PATENT DOCUMENTS

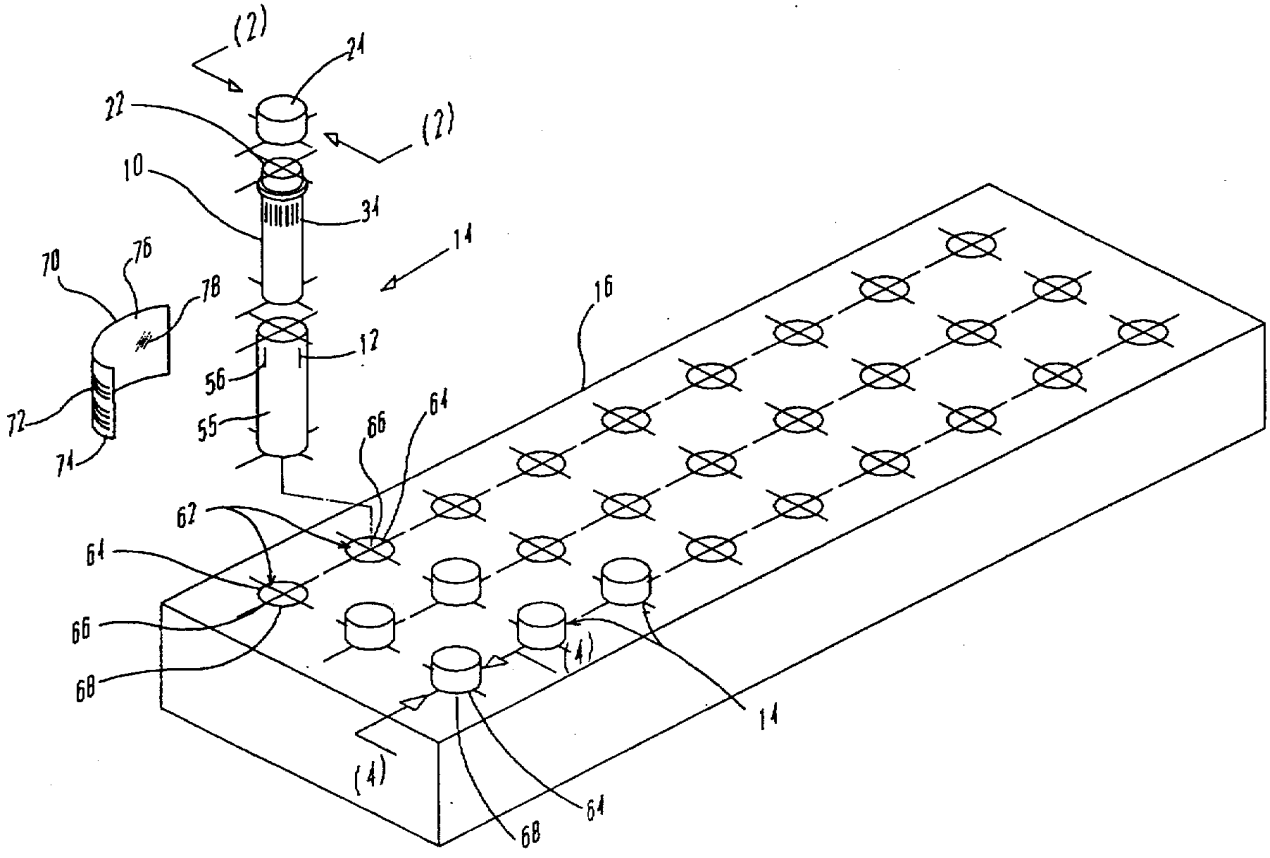
3,707,079	12/1972	Hawker	62/64
3,864,927	2/1975	Li .	
4,314,450	2/1982	Pelloux-Gervais	62/78 X
4,785,953	11/1988	Buchholz et al. .	
5,321,955	6/1994	Leonard .	
5,392,943	2/1995	Delatte et al.	62/64 X
5,419,143	5/1995	Leonard et al.	62/51.1 X
5,427,743	6/1995	Markin .	
5,545,562	8/1996	Cassou et al. .	

Primary Examiner—Christopher B. Kilner
Attorney, Agent, or Firm—Meroni & Meroni

[57] **ABSTRACT**

A sleeve structure and method are provided for use with a cryogenic specimen container which is maintained at a cryogenic temperature below −80° C. to allow for labeling of the specimen container. The sleeve structure includes sidewalls defining a cylindrically shaped interior chamber sized for telescopically receiving a lower portion of a cryogenic specimen container in nested engagement. The sleeve structure has a locking mechanism for holding the sleeve structure in removably secured engagement with specimen container when the specimen container is in nested engagement with the sleeve structure. Identification markings are secured to an exterior side of the sleeve structure.

20 Claims, 4 Drawing Sheets



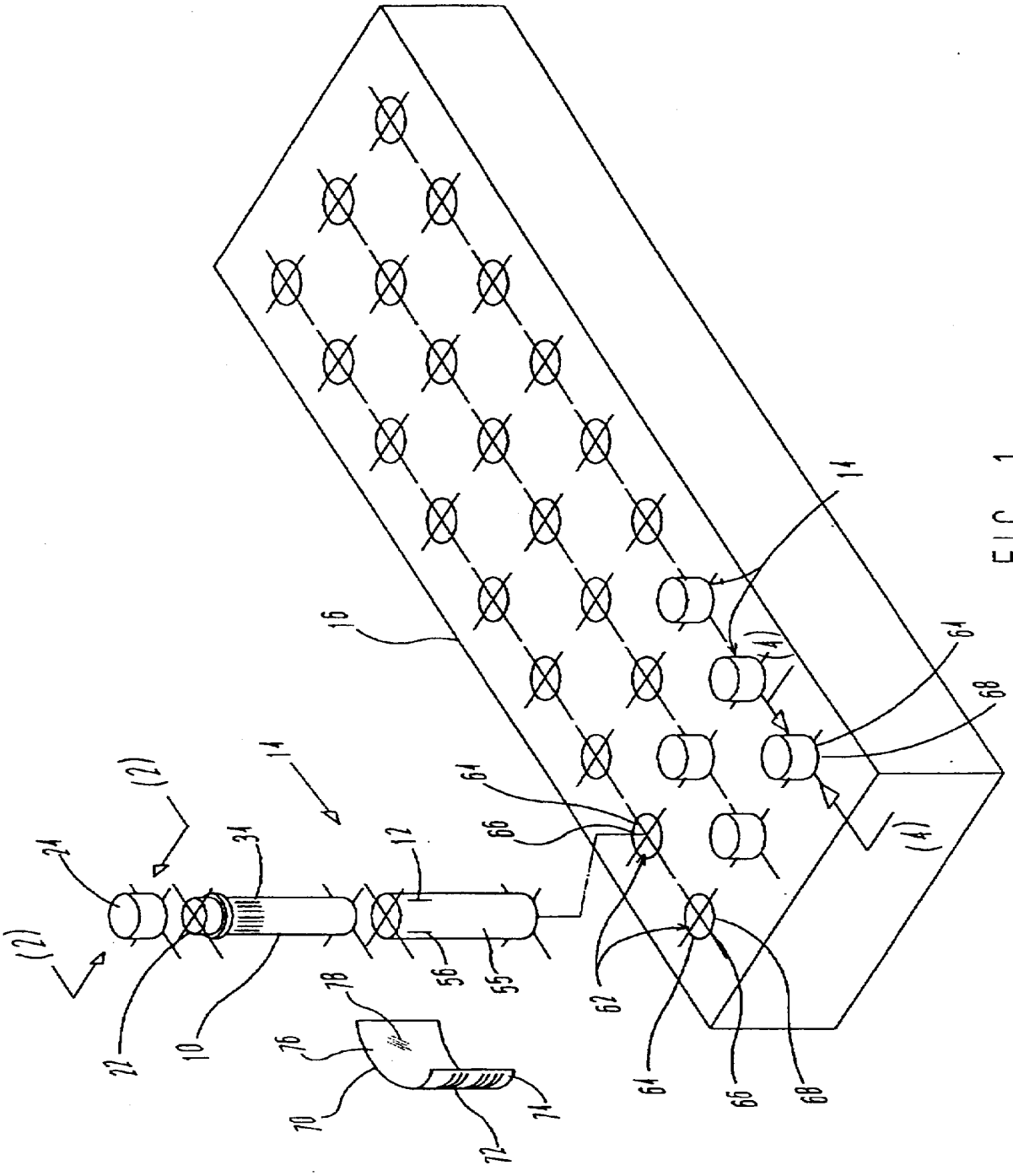


FIG. 1

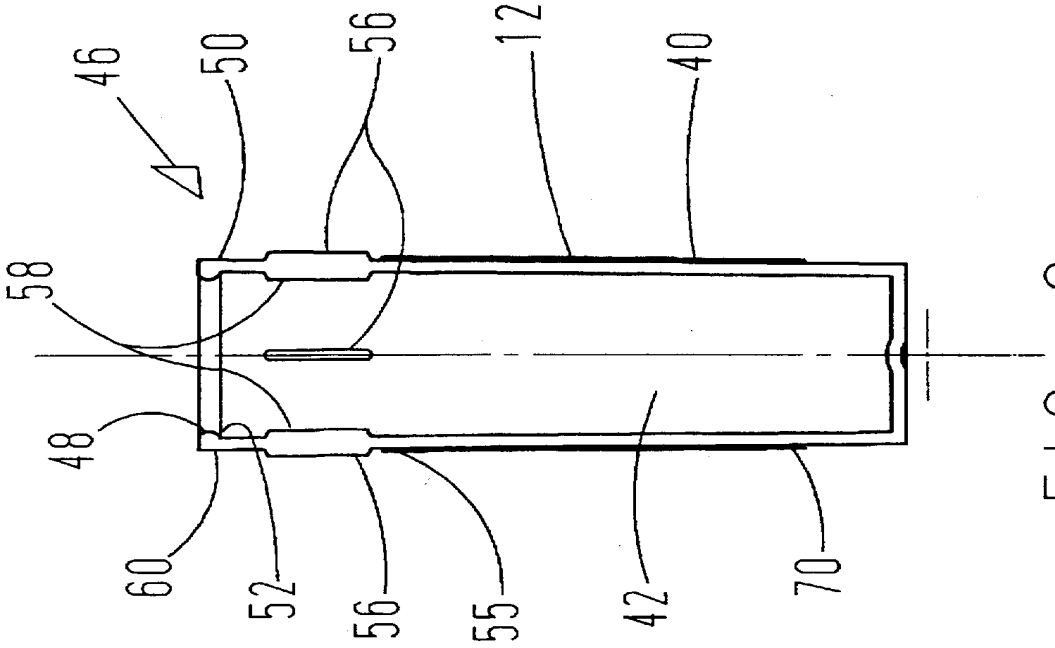
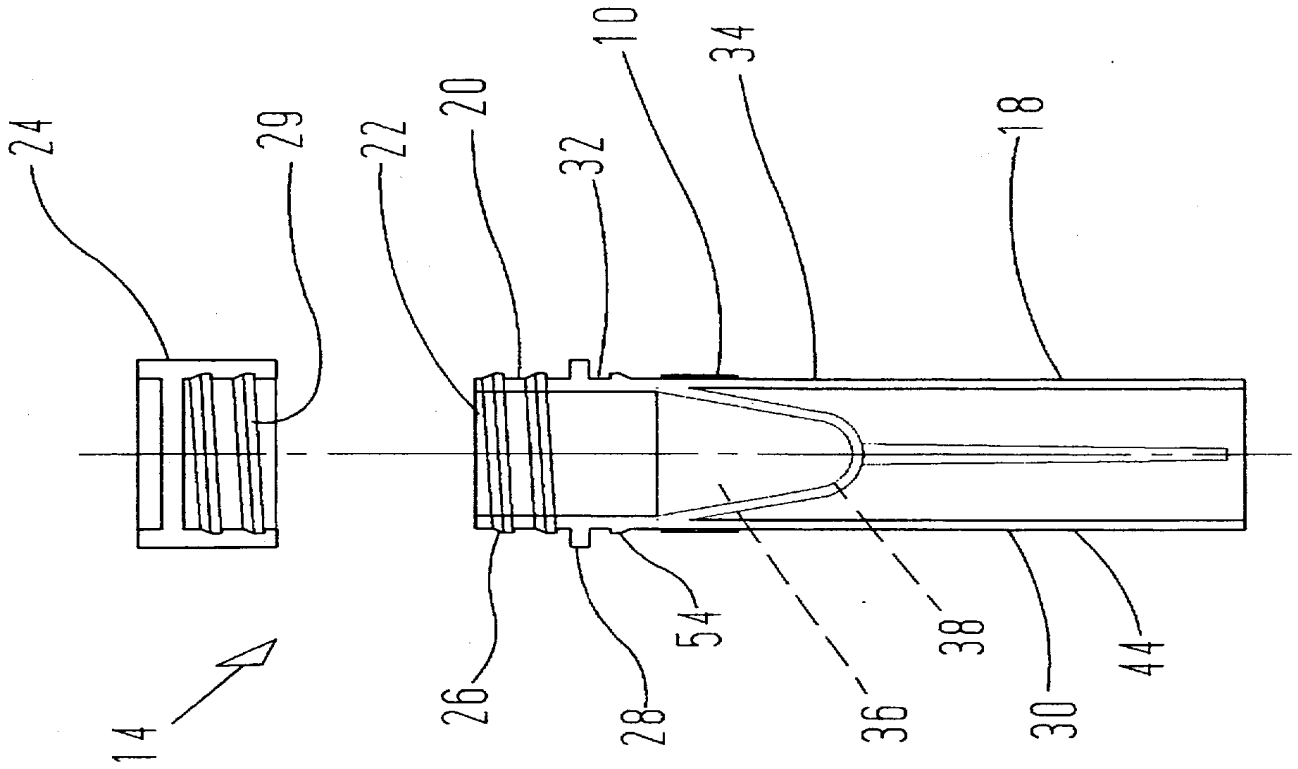

46
50
56
12
40
58
48
60
52
56
55
42
70

FIG. 2


24
29
22
20
32
10
34
18
14
26
28
54
36
38
30
44

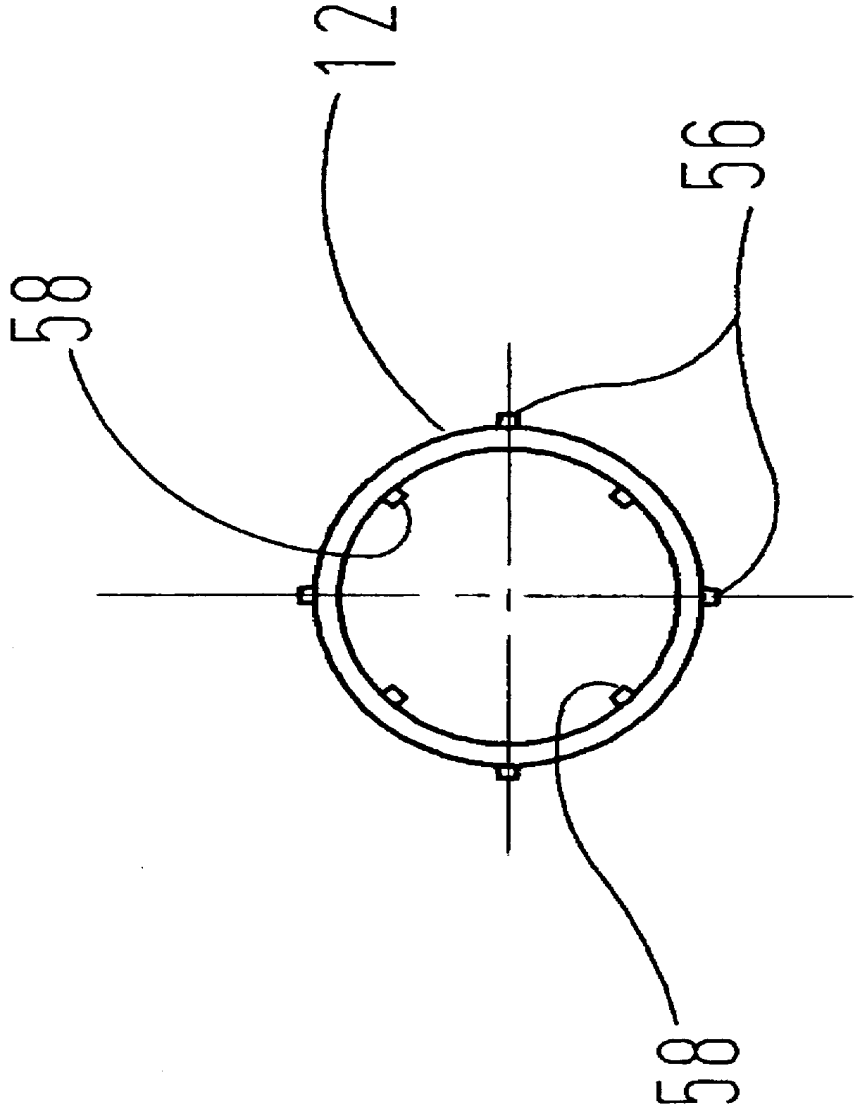


FIG. 3

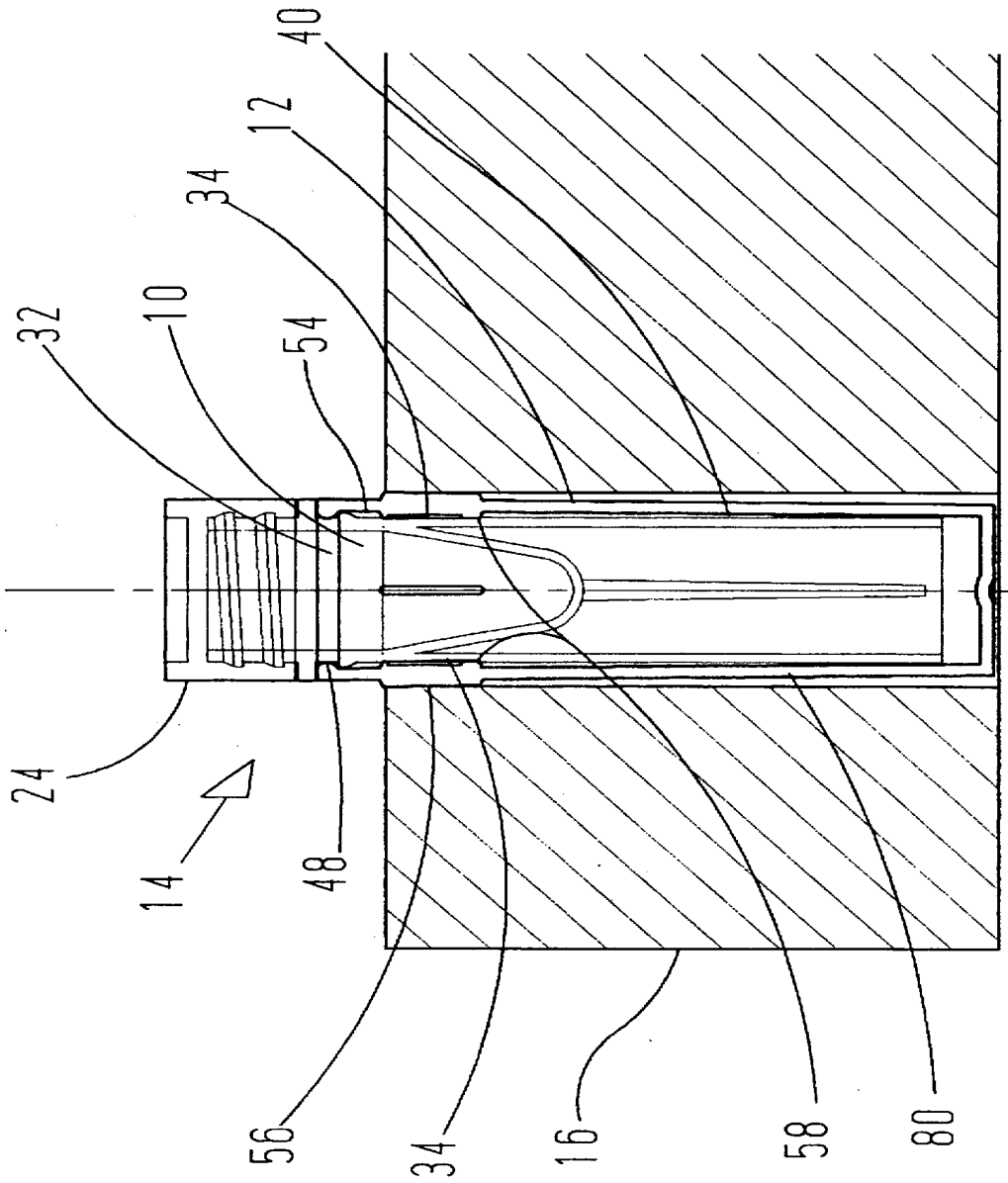


FIG. 4

CRYOGENIC SPECIMEN CONTAINER AND LABELED SLEEVE COMBINATION AND METHOD OF USING SAME

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to cryogenic specimen containers. More particularly, the invention pertains to a cryogenic specimen container and labeled sleeve combination and method of using same to label stored specimens while said specimens are maintained at temperatures of −80° C. or below.

2. Description of the Prior Art

Various forms of cryogenic specimen containers are known in the art. One commonly used form are known as centrifuge tubes, which are often formed of polypropylene to withstand g-forces up to 13,000×G and greater. The tubes are provided with a removable screw cap which is often equipped with a silicone O-ring to maintain its sealing properties at cryogenic temperatures often as low as −180° C.

While centrifuge tubes provide a sufficient means for storing blood serums, blood specimens and the like, these tubes once stored at a cryogenic temperature can become difficult to label for identification purposes. The importance of proper labeling for the identification of specimens is well known in the medical and scientific communities. To this end, various labeling and coding methods are known. For example, cap inserts can be provided in various colors use for in color-coding specimens by inserting the cap insert onto the screw cap of the centrifuge tube. Further, tubes can be imprinted with a white write-on space that allows a user to write thereupon.

While such prior art devices and techniques provide a means for labeling tubes, these devices and techniques fail to provide a means for labeling tubes which are maintained at a cryogenic temperature. Adhesive in the form of adhesive labels, as well as ink will not adhere to tubes at cryogenic temperatures. Further, cap inserts do not provide sufficient space to allow a user to provide necessary identification, such as in the form of a printed bar code.

As will be described in greater detail hereinafter, the method and combination of the present invention solves the aforementioned problems and employs a number of novel features that render it highly advantageous over the prior art.

SUMMARY OF THE INVENTION

Accordingly, it is an object of this invention to provide a method and structure for labeling and thereby tracking cryogenic specimen containers stored at cryogenic temperatures.

Another object of this invention is to provide a manner of utilizing labels carrying identification markings, such as bar code identification.

Still another object of this invention is to provide a method and structure which is easy to use, inexpensive to manufacture, and can be readily adapted for use with centrifuge tubes of the prior art.

To achieve the foregoing and other objectives, and in accordance with the purposes of the present invention a sleeve structure is provided for use with a cryogenic specimen container which is maintained at a cryogenic temperature below approximately −50° C. to allow for labeling of the specimen container. The sleeve structure includes sidewalls defining a cylindrically shaped interior chamber sized for telescopically receiving a lower portion of a cryogenic specimen container in nested engagement. The sleeve structure has a locking mechanism for holding the sleeve structure in removably secured engagement with specimen container when the specimen container is in nested engagement with the sleeve structure.

In accordance with a method of the invention, a method of tracking specimen samples being stored at cryogenic temperatures is provided. The method includes the following steps: providing a cryogenic specimen container adapted for storing a specimen sample therewithin; providing a sleeve structure having sidewalls defining an interior chamber therewithin sized for telescopically receiving a lower portion of the specimen container; labeling the sleeve structure with identification markings; and releasably connecting the sleeve structure to the cryogenic specimen container by telescopically inserting a lower portion of the specimen container into the interior chamber for engagement therewith.

Other objects, features and advantages of the invention will become more readily apparent upon reference to the following description when taken in conjunction with the accompanying drawings, which drawings illustrate several embodiments of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. **1** is a perspective view of the cryogenic specimen container and sleeve combination shown in exploded view for nested engagement with a holder;

FIG. **2** is a sectional exploded view of the present invention taken along line **2**—**2** of FIG. **1**;

FIG. **3** is a top view of the sleeve structure of the present invention; and

FIG. **4** is a sectional view of the present invention taken along line **4**—**4** of FIG. **1**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, FIG. **1** illustrates in exploded view a combination of a cryogenic specimen container **10** and sleeve structure or apparatus **12**. The combination, indicated by the numeral **14**, may be held in storage holder or tray **16**, as later described, which is adapted to hold a plurality of combinations **14** for secured storage and to facilitate easy transportation.

Referring to FIG. **2**, the cryogenic specimen container **10** has a cylindrically shaped tubular body **18**. The tubular body **18** has an upper portion **20** defining an aperture **22**. The upper portion **20** is adapted for receiving a cap **24**. Preferably, the upper portion **20** has external threads **26** for threaded engagement with internal threads **29** of the cap **24**. The upper portion **20** of the tubular body **18** has an outwardly extending flange **28** extending about a circumferential exterior surface **30** of the specimen container **10**. The body **18** also defines an interior chamber **36** sized for holding a specimen sample **38**. The upper portion **20** has an annular grove **32** extending about the circumferential exterior surface **30** adjacent to the flange **28**. A series of spaced apart vertically oriented ridges **34** extend about the exterior surface **30**, as illustrated in FIGS. **1** and **2**. It should be noted that the cryogenic specimen container **10** described herein is of the type known in the art as a centrifuge tube and accordingly the sleeve structure **12** and method disclosed may be implemented with existing tubes to provide an

inexpensive and effective manner of solving the aforementioned problems of the prior art.

The sleeve structure **12** has sidewalls **40** defining a cylindrically shaped interior chamber **42** sized for telescopically receiving a lower portion **44** of the tubular body **18** in nested engagement, as illustrated in FIG. **4**. The sleeve structure **12** has a locking portion **46** for releasably engaging the tubular body **18** to hold the sleeve structure **12** in removably secured engagement with tubular body **18** when the tubular body **18** is in nested engagement with the sleeve structure **12**. Preferably, the sleeve structure **12** is formed of synthetic plastic, such as polypropylene, which is designed to withstand cryogenic temperatures of −80° C. or more without cracking or deforming.

Preferably, the locking portion **46** includes an interior annular ridge **48** extending about an upper edge **50** of the sidewalls **40** on an interior side **52**. The interior annular ridge **48** is releasably engageable with the annular grove **32**, as illustrated in FIG. **4**. The upper portion **20** of the tubular body **18** has an exterior annular ridge **54**. The exterior annular ridge **54** and flange **28** are positioned on opposite sides of the annular grove **32**. Accordingly, interior annular ridge **48** is flexibly or resiliently movable over the exterior annular ridge **54** to provide snap fit engagement of the interior annular ridge **54** within the annular grove **32** when the tubular body **18** is moved telescopically within the sleeve structure **12** for nested engagement therewith.

Referring to FIGS. **2–4**, an outer surface **55** of the sleeve structure **12** has a plurality of spaced apart vertically oriented ridges **56** and the interior side **52** of the sidewalls **40** of the sleeve structure **12** has a plurality of spaced apart vertically oriented ridges **58**. The ridges **56,58** are disposed on an upper portion **60** of the sleeve structure **12** below the interior annular ridge **48**. The ridges **56** provide locking engagement of the combination **14** when the combination **14** is inserted into a receiving aperture **62** of the tray **16**. Upper edges **64** extending about an opening **66** of the aperture **62** preferably contain a plurality of small ridges **68** which produce a locking type action when the ridges **56** are in pressing engagement thereagainst or between.

The plurality of spaced apart vertically oriented ridges **58** on the interior side **52** of the sidewalls **40** are in pressing engagement against the circumferential exterior surface **30** of the specimen container **10** when the specimen container **10** and sleeve structure **12** are in engagement with one another. The ridges **58** are in pressing engagement between the ridges **34** (FIG. **4**) to prevent twisting or turning of the sleeve structure **12** on the container **10**. Further, when the specimen container **10** and sleeve structure **12** are engaged, the tubular body **18** and sidewalls **40** are spaced apart to define a gap **80** therebetween, as best illustrated in FIG. **4**.

A label **70** has identification markings **72**, such as a bar code, printed on a first side **74** of the label. A second side **76** of the label **70** has an adhesive layer **78** secured thereto for adhesively securing the label **70** to the outer surface **55** of the sleeve structure **12**. Alternatively, the outer surface **55** could be imprinted with a write-on space. In use, the label **70** can be printed and secured to the sleeve structure **12** while at room temperature. The sleeve structure **12** is then attached to the specimen container **10** which will already typically have a sample **38** contained within and is being stored or otherwise maintained at a cryogenic temperature, such as between −80° to −198° C.

According to a method of tracking specimen samples being stored at cryogenic temperatures, the method includes the following steps: providing a cryogenic specimen container **10** adapted for storing a specimen sample **38** therewithin; providing a sleeve structure **12** sized for telescopically receiving a lower portion of the specimen container **10**; labeling the sleeve structure **12** with identification markings **72**; and releasably connecting the sleeve structure **12** to the cryogenic specimen container **10**. The step of providing a cryogenic specimen container **10** includes the step of storing a specimen sample **38** therewithin and maintaining the specimen sample **38** at a cryogenic temperature by placing the container **10** in a suitable freezing unit.

Although the invention has been described by reference to some embodiments it is not intended that the novel device be limited thereby, but that modifications thereof are intended to be included as falling within the broad scope and spirit of the foregoing disclosure, the following claims and the appended drawings.

I claim:

1. A combination of a cryogenic specimen container and sleeve structure comprising: said cryogenic specimen container having a cylindrically shaped tubular body, the tubular body having an upper portion defining an aperture, the upper portion being adapted for receiving a cap thereon, said sleeve structure having sidewalls defining a cylindrically shaped interior chamber therewithin sized for telescopically receiving a lower portion of the tubular body in nested engagement, said sleeve structure having locking means releasably engaging the tubular body for holding the sleeve structure in removably secured engagement with the tubular body when the tubular body is in nested engagement with the sleeve structure.

2. The combination of claim **1**, wherein the sleeve structure includes means for labeling the sleeve structure with identification markings.

3. The combination of claim **2**, wherein the labeling means includes a label having identification markings printed thereon, the label being secured to an outer surface of the sleeve structure.

4. The combination of claim **1**, wherein the upper portion of the tubular body has a flange extending about a circumferential exterior surface of the specimen container, the upper portion having an annular grove extending about the circumferential exterior surface adjacent to the flange, said locking means including an interior annular ridge extending about an upper edge of the sidewalls on an interior side of the sidewalls, the interior annular ridge being releasably engageable with the annular grove.

5. The combination of claim **4**, wherein the upper portion of the tubular body has an exterior annular ridge, the exterior annular ridge and flange being positioned on opposite sides of the annular grove, interior annular ridge being movable over the exterior annular ridge to provide snap fit engagement of the interior annular ridge within the annular grove when the tubular body is moved telescopically with sleeve structure for nested engagement therewith.

6. The combination of claim **4**, wherein the outer surface of the sleeve structure has a plurality of spaced apart vertically oriented ridges and the interior side of the sidewalls of the sleeve structure has a plurality of spaced apart vertically oriented ridges, said ridges being disposed on an upper portion of the sleeve structure.

7. The combination of claim **4**, wherein the plurality of spaced apart vertically oriented ridges on the interior side of the sidewalls of the sleeve structure are in pressing engagement against the circumferential exterior surface of the specimen container when the specimen container and sleeve structure are in engagement with one another.

8. A sleeve structure for use with a cryogenic specimen container maintained at a cryogenic temperature of −80° C.

or below to allow for labeling of said specimen container, said sleeve structure comprising: sidewalls defining a cylindrically shaped interior chamber therewithin sized for telescopically receiving a lower portion of a cryogenic specimen container in nested engagement, and locking means releasably engaging the specimen container for holding the sleeve structure in removably secured engagement with the specimen container when the specimen container is in nested engagement with the sleeve structure, the sleeve structure being formed of material adapted for use at cryogenic temperatures below −80° C.

9. The sleeve structure of claim **8**, further comprising means for labeling the sleeve structure with identification markings.

10. The sleeve structure of claim **9**, wherein the labeling means includes a label having identification markings printed thereon, the label being secured to an outer surface of the sleeve structure.

11. The sleeve structure of claim **9**, wherein said locking means includes an interior annular ridge extending about an upper edge of the sidewalls on an interior side of the sidewalls, the specimen container having an annular grove extending about a circumferential exterior surface, the interior annular ridge being releasably engageable with the annular grove.

12. The sleeve structure of claim **11**, wherein the interior annular ridge is in snap fit engagement within the annular grove when the tubular body is moved telescopically with sleeve structure for nested engagement therewith.

13. The sleeve structure of claim **11**, wherein an outer surface of the sleeve structure has a plurality of spaced apart vertically oriented ridges and the interior side of the sidewalls of the sleeve structure has a plurality of spaced apart vertically oriented ridges, said ridges being disposed on an upper portion of the sleeve structure.

14. A method for labeling a cryogenic specimen container maintained at a cryogenic temperature of below −50° C., the method comprising the steps of:

(a) providing a cryogenic specimen container adapted for storing a specimen sample therewithin;

(b) providing a sleeve structure having sidewalls defining an interior chamber therewithin sized for telescopically receiving a lower portion of the specimen container, the sleeve structure carrying identification markings; and

(c) releasably connecting the sleeve structure to the cryogenic specimen container by telescopically inserting a lower portion of the specimen container into the interior chamber for engagement therewith.

15. The method of claim **14**, wherein the step of providing a cryogenic specimen container comprises the step of providing a cyclindrically shaped centrifuge tube.

16. The method of claim **14**, wherein the step of providing a sleeve structure includes the step of printing identification markings on a label and securing the label to an outer surface of the sleeve structure where the sleeve structure is maintained at approximately room temperature.

17. A method of tracking specimen samples being stored at cryogenic temperatures, the method comprising the steps of:

(a) providing a cryogenic specimen container adapted for storing a specimen sample therewithin;

(b) providing a sleeve structure having sidewalls defining an interior chamber therewithin sized for telescopically receiving a lower portion of the specimen container;

(c) labeling the sleeve structure with identification markings; and

(d) releasably connecting the sleeve structure to the cryogenic specimen container by telescopically inserting a lower portion of the specimen container into the interior chamber for engagement therewith.

18. The method of claim **17**, wherein the step of providing a cryogenic specimen container comprises the step of providing a cyclindrically shaped centrifuge tube.

19. The method of claim **17**, wherein the step of providing a cryogenic specimen container includes the step of storing a specimen sample therewithin and maintaining the specimen sample at a cryogenic temperature.

20. The method of claim **17**, wherein the step of labeling includes printing identification markings on a label and adhesively securing the label to the an outer surface of the sleeve structure.

* * * * *

US005855289A

United States Patent [19]

Moore

[11] **Patent Number: 5,855,289**

[45] **Date of Patent: Jan. 5, 1999**

[54] **CENTRIFUGALLY LOADED SELF-SEALING INTEGRAL ONE-PIECE CAP/CLOSURE**

[75] Inventor: **Patrick Q. Moore**, Gilroy, Calif.

[73] Assignee: **Beckman Instruments, Inc.**, Fullerton, Calif.

[21] Appl. No.: **842,986**

[22] Filed: **Apr. 25, 1997**

[51] **Int. Cl.**[6] **B65D 53/00**

[52] **U.S. Cl.** **215/270**; 422/99; 422/102; 422/72; 215/271; 215/273; 215/276

[58] **Field of Search** ..... 422/99, 102, 72; 215/270, 271, 273, 276, 278, DIG. 3, 355, 320; 494/16, 85; 220/796, 801

[56] **References Cited**

U.S. PATENT DOCUMENTS

718,643	1/1903	Lees .	
3,924,772	12/1975	Magnani	215/276
4,076,170	2/1978	Chulay et al.	233/26
4,080,175	3/1978	Chulay et al.	23/292
4,304,356	12/1981	Chulay et al.	233/26
4,844,273	7/1989	Hawkins	215/329
5,127,895	7/1992	Pawlovich	494/16
5,291,783	3/1994	Hall	73/426
5,325,977	7/1994	Haynes et al.	215/307
5,361,922	11/1994	Moore et al.	215/364
5,395,001	3/1995	Moore	215/364
5,458,252	10/1995	Logel	215/271

FOREIGN PATENT DOCUMENTS

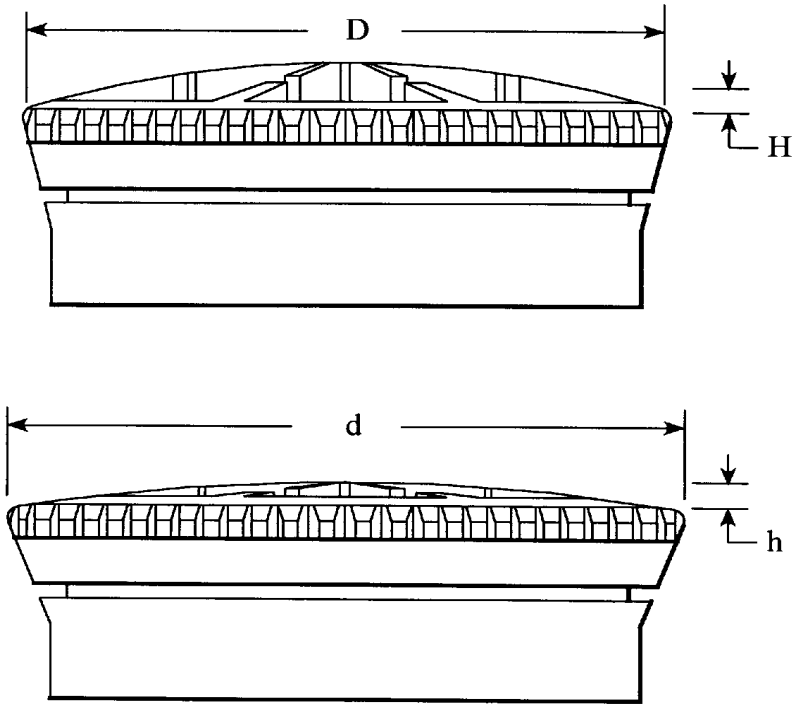
4247/26 10/1926 Australia .

Primary Examiner—Jill Warden
Assistant Examiner—Fariborz Moazzam
Attorney, Agent, or Firm—William H. May; P. R. Harder; Thomas Schneck

[57] **ABSTRACT**

A capping and sealing assembly for a sample-holding centrifuge container which features a self-sealing lid that forms a fluid-tight seal in an opening of the canister with a predetermined amount of force, with the force being dependent upon the centrifugal load to which the capping assembly is subjected. The lid includes a cover portion and a peripheral member surrounding the cover portion and extending transverse thereto. The lid is disposed within an open end of the container, with the peripheral member having a frusto-conical surface that faces the container's wall. A gasket is disposed about the frusto-conical surface, forming a fluid-tight and air-tight seal with the cylindrical wall. A plurality of arcuate ribs extend across the cover portion, between opposed areas of the peripheral member. Each of the ribs are adapted to flex, under centrifugal force, expanding the opposed areas outwardly. In this manner, the sealing force between the peripheral member and the wall is increased.

20 Claims, 6 Drawing Sheets



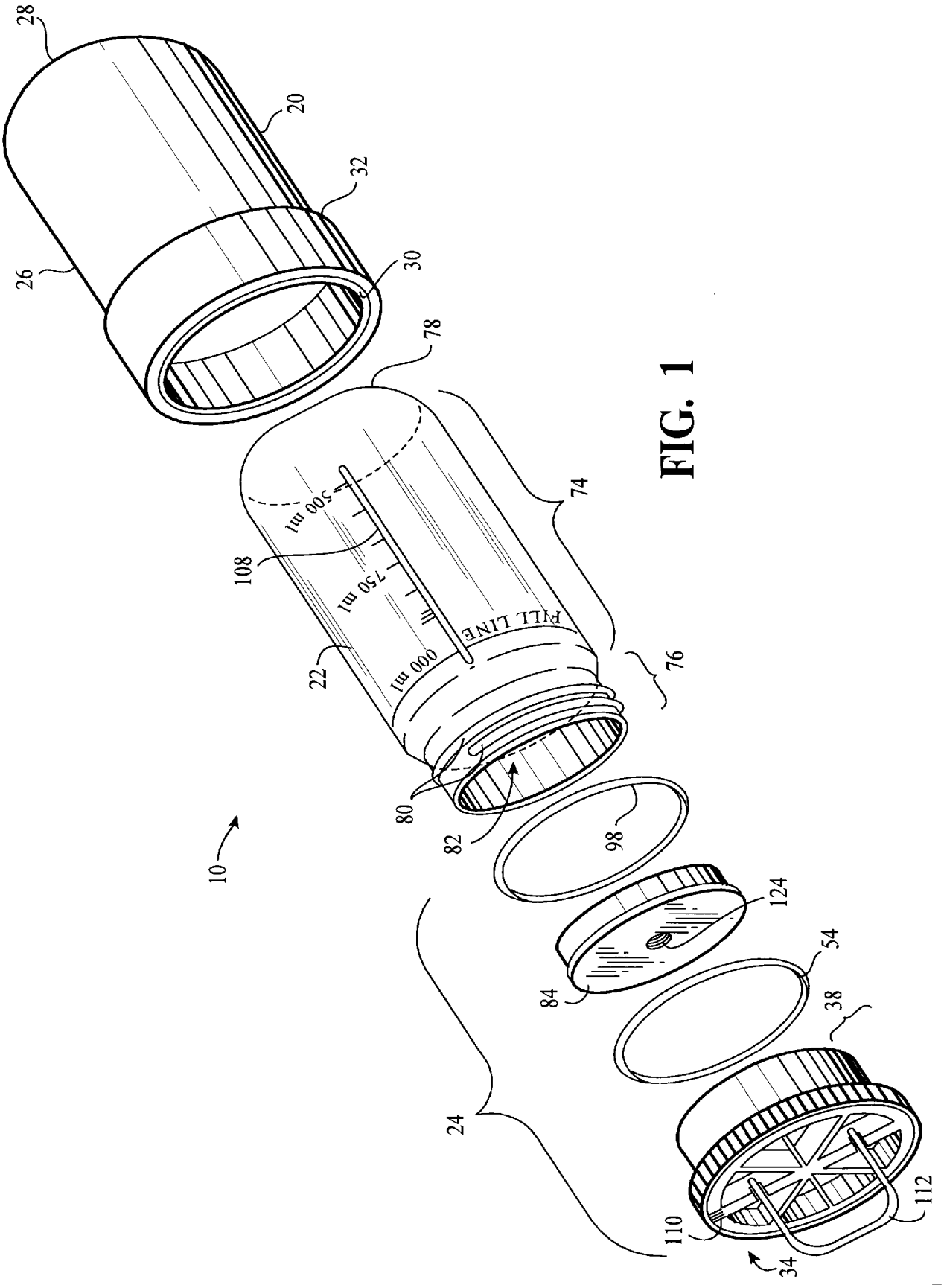

28
20
32
26
30
78
74
500 ml
750 ml
000 ml
FILL LINE
108
22
76
80
82
98
10
124
54
84
38
24
110
112
34

FIG. 1

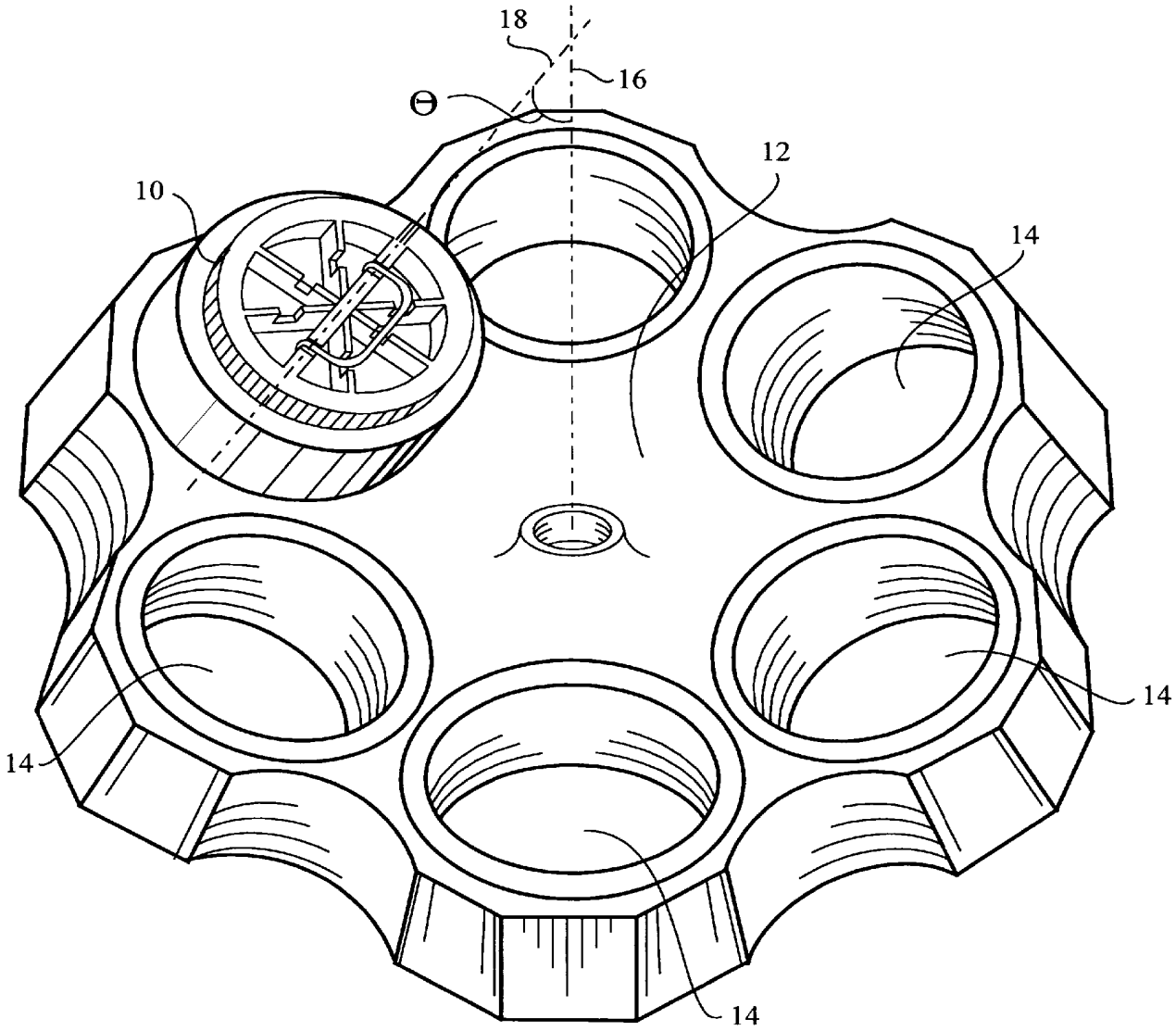


FIG. 2

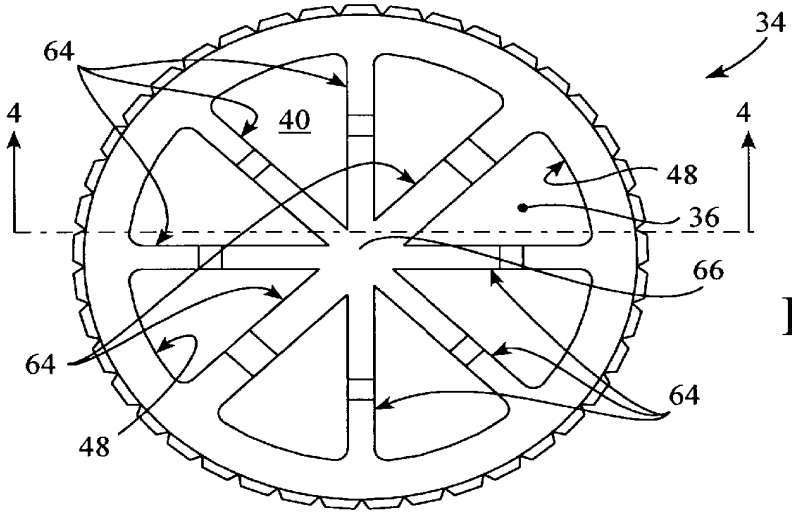


FIG. 3

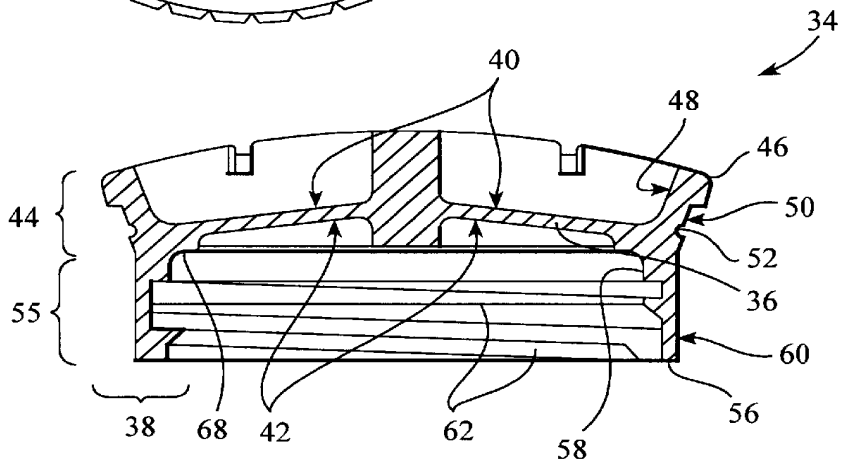


FIG. 4

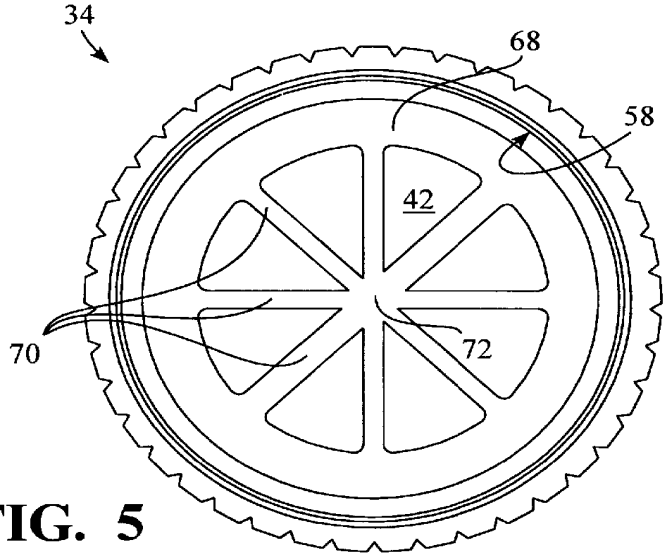


FIG. 5

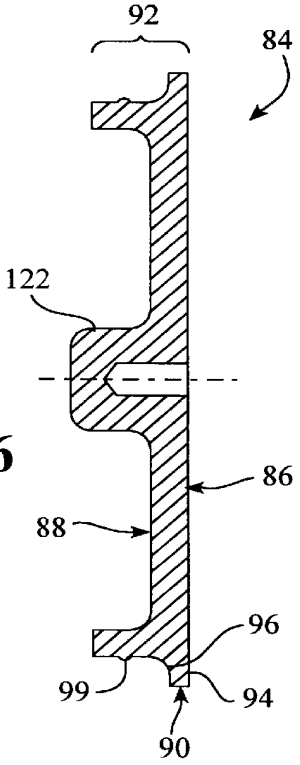


FIG. 6

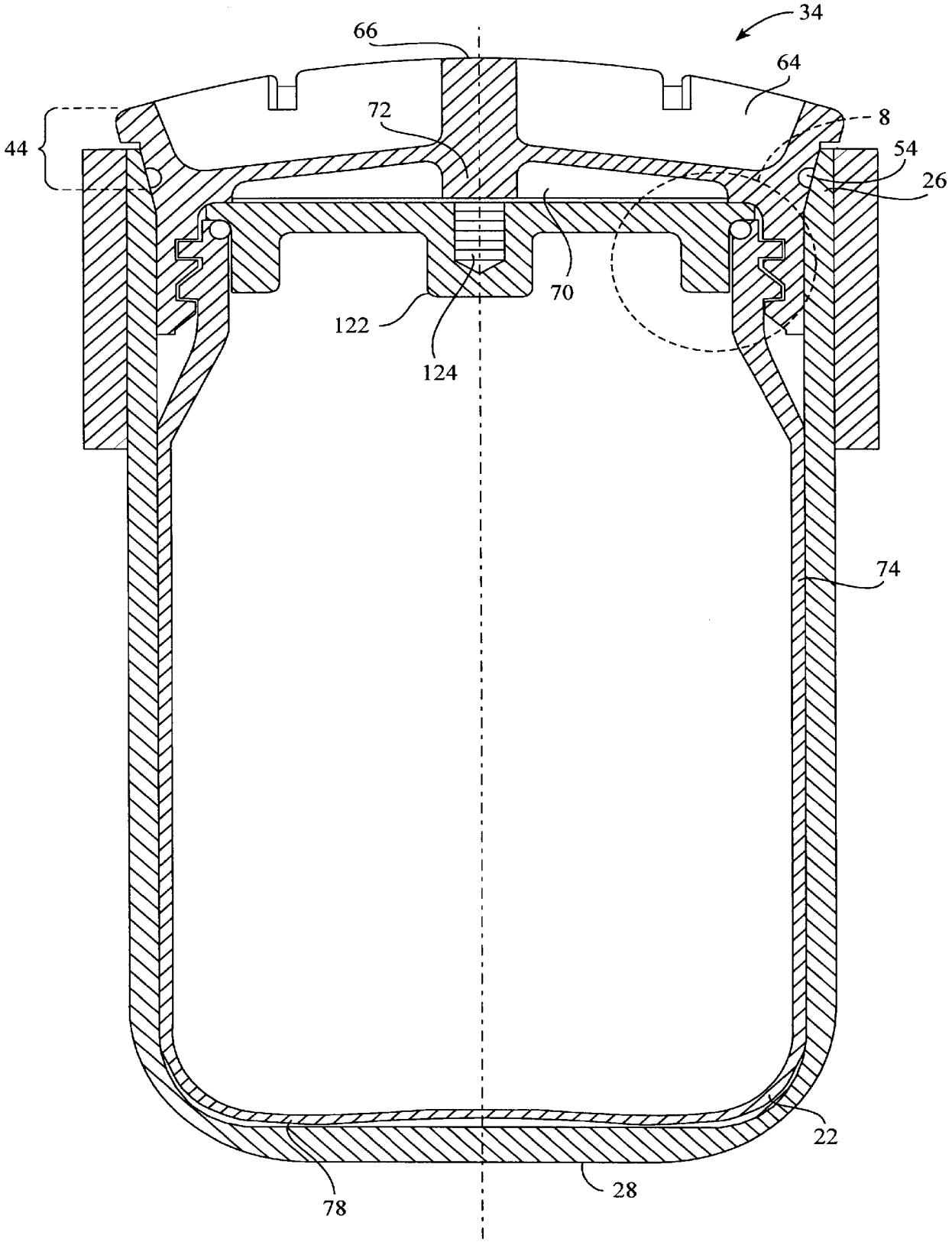


FIG. 7

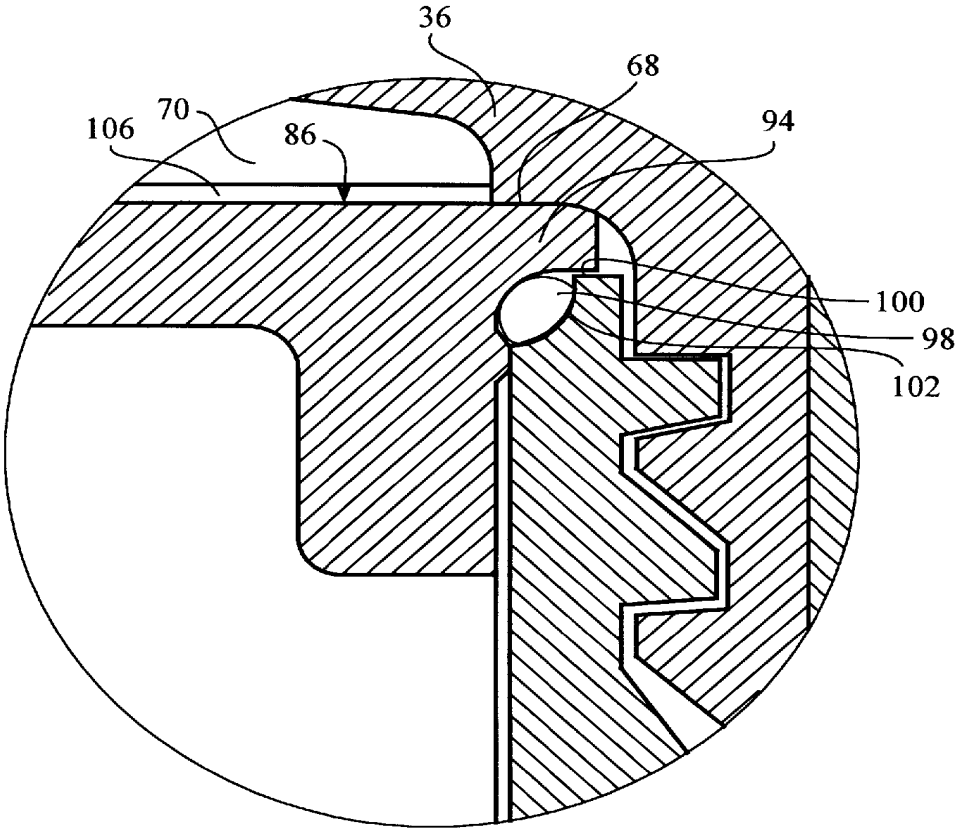


FIG. 8

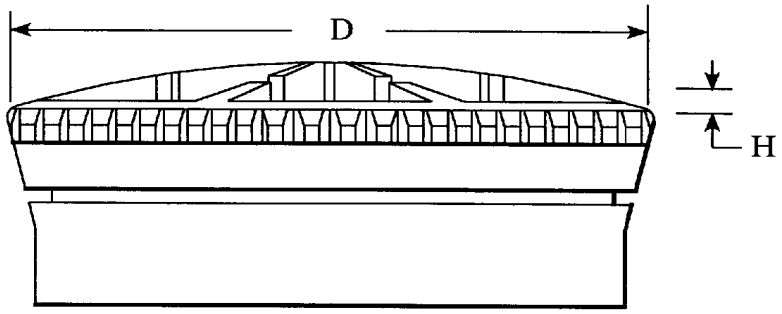


FIG. 9

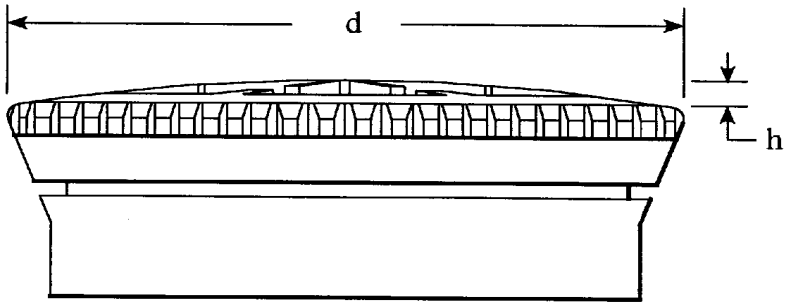


FIG. 10

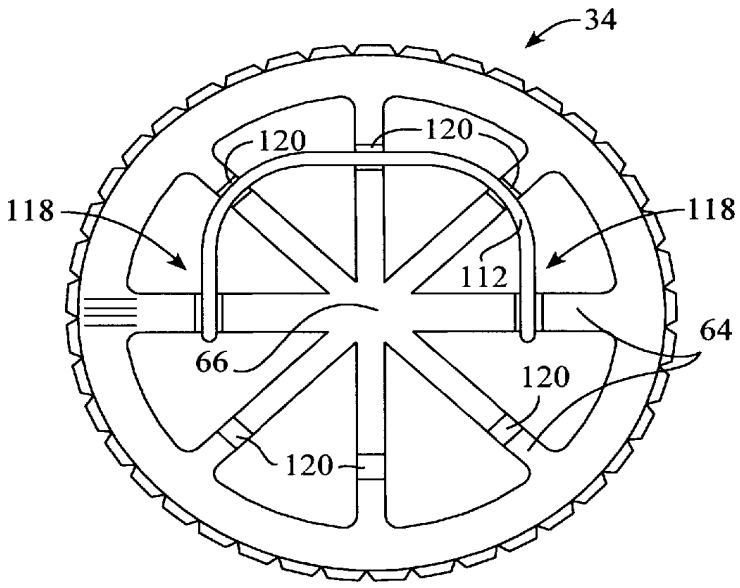


FIG. 11

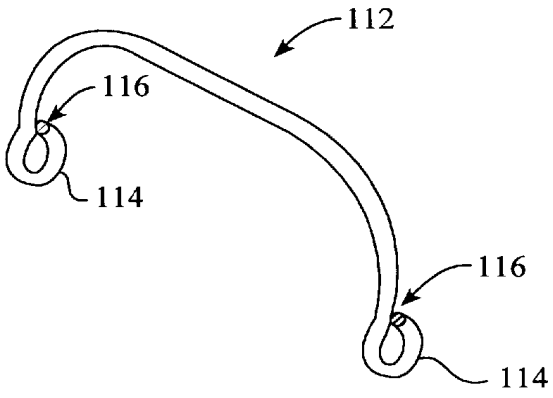


FIG. 12

CENTRIFUGALLY LOADED SELF-SEALING INTEGRAL ONE-PIECE CAP/CLOSURE

DESCRIPTION

1. Technical Field

The present invention pertains to the field of centrifugation. Specifically, the present invention pertains to an improved capping and sealing assembly for removable sample-holding containers employed in centrifuges.

2. Background Art

Centrifuges are commonly used in medical and biological industries for separating and purifying materials of differing densities, such as viruses, bacteria, cells and proteins. A centrifuge includes a rotor and a container to support a sample undergoing centrifugation. The rotor is designed to hold the sample container while it spins up to tens of thousands of revolutions per minute. To avoid spillage, evaporation, or aerosoling of the sample, a cover is placed onto the container so as to provide a fluid-tight seal therebetween.

During centrifugation, hydrostatic pressure within the container can compromise the seal integrity of the covered container. The hydrostatic pressure may force the sample to pass between the cover and the receptacle. Avoiding this type of leakage poses a great challenge when designing centrifuge sample containers. The prior art is replete with differing designs for sample-holding containers from which inspiration may be drawn to provide improved sample-holding centrifuge containers.

U.S. Pat. No. 718,643 to Lees et al. discloses a sealing-jar for preserving articles of food, FIG. 1, including a body of a receptacle (a), a recess (b), a cover (c), a flat flange (d), a circular down-turned rib (e), and a rubber gasket (f). A seal is achieved by the gasket (f) fitting around the cover (c), beneath the flange (d), so as to bear against the recess (b), but this seal is easily compromised by centrifugal forces.

Australian Pat. No. 4247/26 to Lucke et al. discloses an apparatus for sealing bottles and jars, FIGS. 1–3, containing a domed disc stopper 8 having a downwardly projecting wall 9 near its outer edge. The wall 9 is inclined to match the seating 7 at the top of a rigid neck 5 of a jar or bottle. A rigid cap 12 has internal screw-threads 6 that are designed to thread onto the neck 5. A resilient ring 10 fits into an annular groove in the face of the stopper, col. 3 lines 4–8. The resilient ring 10 seats against the neck 5 by the cap 12 pressing against the stopper 8.

U.S. Pat. No. 3,924,772 to Magnani et al. discloses an airtight container cap, FIGS. 1–3, containing a ring-nut 1 have an upper circular hole 2, a slot 3 on the side surface thereof and threads 4; a jar 7 with a threaded neck 6; glass stopper 8 having one groove 9 in the upper portion a second groove 10 in the lower portion and a shoulder 12; and a circular gasket 11. The circular gasket 11 is positioned within groove 10 of the glass stopper 8. The glass stopper 8 is then mounted inside of ring-nut 1 through hole 2. Ring-nut 1 is then threaded onto the neck 6 of a jar 7, forming a hermetic seal.

U.S. Pat. No. 4,844,273 to Hawkins et al. discloses a closure with enhanced sealing for a container, FIGS. 1–3, comprising a container neck lip 30 and a cap 18 having an inner skirt 24, a top 20 and a depending coaxial outer skirt 22. The outer skirt has internal threads 26 for engaging the complementary external threads 28 of the container neck. The inner skirt 24 has an interference fit with the inside of the container neck lip 30, thus, forming one element of the enhanced seal. A bead 32 projects inwardly from the depending skirt 22 and provides the second element of the enhanced seal by maintaining peripheral contact against the outside of the container neck lip 30. An o-ring 34 is positioned between the outer and inner skirts, 22 and 24, respectively, and becomes compressed between the top 20 and the container lip 30 to maintain a hermetic seal while the cap 18 is threaded on the container neck 12. The rigid inner skirt firmly presses against the inside of lip 30 and co-acts with the inwardly directed bead 32 maintaining peripheral contact with the outside lip 30, which helps to maintain the hermetic seal by retaining the o-ring 34 in its compressed state.

U.S. Pat. No. 5,291,783 to Hall discloses a tube 10 for use in a fixed angle centrifuge rotor having indicia 20 thereon indicating the level to which the tube may be filled with liquid without risk of spillage due to meniscus re-orientating.

U.S. Pat. No. 5,325,977 to Haynes et al. discloses a vented closure for a capillary tube assembly 10. The assembly 10 includes a capillary tube 12 having a bore extending therethrough and a cap 14 slidably mounted to on end of the tube 12. The cap 14 includes an enlarged head 16 and a substantially cylindrical body 18. One or more vent grooves 20 are formed into the body which allows air to escape when the cap 14 is in a first slidable position. The groove 20 typically extends parallel to the longitudinal axis of the cylindrical body 18.

U.S. Pat. No. 5,458,252 discloses an invertible pressure-responsive sealing cap 1 for attachment to a container 2 having a mouth 4 with an outwardly facing threaded portion 12. The mouth 4 has an inner cylindrical sealing surface 6. The cap 1 has a threaded portion 3 disposed on a cap skirt 5, with the threaded portion 3 facing inwardly toward a cap axis 7. A central dome portion 9 is symmetrically disposed about the cap axis 7 and extends outwardly therefrom, terminating in an annular portion 11. The dome portion 9 is initially concave and extends into the mouth 4 of the container 2. The interface of the dome portion 9 and the annular portion 11 define a first flexure area 17. A sealing portion 13 is disposed about the annular portion 11, defining a second flexure area 21 thereat. The sealing portion 13 includes an outwardly facing cylindrical surface 23. In operation, the cap 1 is mated to the container 2 and pressure build-up therein causes the dome portion 9 to flatten, increasing the sealing force between the sealing surfaces 23 and 6. A drawback with the aforementioned containers is that the fluid-tight integrity of the seals is compromised by samples egressing therethrough during centrifugation, which has led to the development of seals which employ centrifugal force to drive a cap or plug against a container.

U.S Pat Nos. 5,127,895 to R. Pawlovich; 5,395,001 to P. Moore; 5,361,922 to P. Moore et al.; 4,304,356 to S. Chulay et al.; 4,290,550 to S. Chulay et al.; 4,080,175 to S. Chulay et al.; and 4,076,170 to S. Chulay et al., all assigned to the assignee of the present invention, disclose centrifuge containers which achieve a seal by having a cap or plug forced against a container under centrifugal force. In some of these patents, deformable o-rings are used as part of the seal mechanism. Tapered surfaces, annular ridges and annular grooves are all employed, as in U.S. Pat. No. 5,395,001, to achieve a sealed sample.

What is needed is a capping assembly for a sample-holding centrifuge container that maintains a fluid-tight seal during high-speed centrifugation, increasing the sealing force proportional to a centrifugal load to which the container is subjected.

SUMMARY OF THE INVENTION

A capping assembly for a sample-holding centrifuge container features a self-sealing lid that seals an opening of the container with a predetermined amount of force, with the force being dependent upon the centrifugal load to which the capping assembly is subjected. The canister includes a closed end, an open end, disposed opposite to the closed end, and a cylindrical wall extending therebetween. The lid includes a cover portion and a peripheral member surrounding the cover portion and extending transverse thereto. The lid is disposed within the open end, with the peripheral member having a frusto-conical surface that faces the cylindrical wall. A gasket is disposed about the frusto-conical surface, forming a fluid-tight and airtight seal with the cylindrical wall. As used herein, a fluid-tight seal means that the seal is impervious to both liquid flow and air flow. A plurality of arcuate ribs extend across the cover portion. Each of the plurality of ribs is adapted to flex, under centrifugal load, expanding the peripheral member outwardly. In this manner, the sealing force between the peripheral member and the cylindrical wall is increased.

Preferably, the self-sealing lid is employed in a dual-vessel centrifuge container. In addition to the canister, the dual-vessel centrifuge container includes a receptacle having a tubular portion extending from a threaded neck portion, terminating in a closed nadir. The neck portion includes a plurality of threads and defines an open mouth. The peripheral member includes a threaded region which engages the plurality of threads of the neck portion. A sealing device, e.g., an o-ring or other type of elastomer or plastomeric material, is disposed between the second major side and the neck to form a fluid-tight and air-tight seal therebetween. The relative dimensions of the lid, canister and receptacle are chosen so that the receptacle fits within the canister. With the receptacle placed in the canister, the frusto-conical surface forms a fluid-tight and air-tight seal with the cylindrical wall and the tubular portion is spaced apart from the cylindrical wall, with the nadir being positioned proximate to, and spaced-apart from, the closed end.

It is preferred that the aforementioned sealing device include a stopper having first and second opposed major surfaces and a peripheral surface extending therebetween. An annular depending portion extends from the second major surface away from said first major surface, defining an annular flange and a shoulder therebetween. The depending portion is spaced-apart from the peripheral surface, defining an annular flange. An annular gasket is disposed about the shoulder, and the depending portion is adapted to fit within the mouth. In this fashion, the gasket rests against the neck. The second major side of the cover portion includes an annular contact area that extends away from the second major surface and coincides with the annular flange upon the lid being threaded onto the neck, with the remaining portion of the second major side being spaced apart from the first major surface.

Finally, the receptacle includes a first alignment mark and the lid includes a second alignment mark, with both of the alignment marks arranged so as to be axially aligned after a predetermined amount of rotational movement between threaded region and the neck. In this manner, the annular gasket is subjected to a preset amount of torque to ensure a fluid-tight and air-tight seal is present. In the preferred embodiment, the first alignment mark consists of a recess formed into the tubular wall so as to extend along a length thereof. In this design, the recess functions as a vent to allow fluid and air to move freely as the receptacle is being inserted or extracted from the canister. This prevents a vacuum, or positive pressure, from being present between the canister and the receptacle, thereby facilitating the canister's insertion to, or removal from, the receptacle.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an exploded perspective view of the capping assembly employed in a dual-vessel removable sample-holding centrifuge container, in accord with the present invention.

FIG. **2** is a perspective view showing a dual-vessel removable sample-holding centrifuge container of FIG. **1** placed in a centrifuge rotor, in accord with the present invention.

FIG. **3** is a top down view of a lid shown in FIG. **1**.

FIG. **4** is a cross-sectional view of the lid shown in FIG. **1**, taken along lines **4**—**4**.

FIG. **5** is a bottom view of the lid shown in FIG. **3**.

FIG. **6** is a cross-sectional view of a stopper or plug shown in FIG. **1**.

FIG. **7** is a cross-sectional view of the container shown in FIG. **1**, with the capping assembly shown in a final seating position.

FIG. **8** is a detailed view of the container shown in FIG. **7**.

FIG. **9** is a side view of the lid shown in FIG. **3** when at rest.

FIG. **10** is the lid shown in FIG. **9** when subjected to centrifugal loading.

FIG. **11** is a top down view of the lid shown in FIG. **3**, having a handle disposed thereon.

FIG. **12** is perspective view of the handle shown in FIG. **11**.

BEST MODE FOR CARRYING OUT THE INVENTION

With reference to both FIGS. **1** and **2**, a dual vessel centrifuge container **10** is shown for use in a fixed-angle centrifuge rotor **12** of the type having a plurality of bores **14** disposed radially symmetric about the rotor **12**'s spin axis **16**. In fixed angle centrifuge rotor **12**, a lengthwise axis **18** of the centrifuge container forms an angle Θ, with respect to the spin axis **16**. The centrifuge container **10** includes a canister **20**, a receptacle **22** and a capping assembly **24**. The canister **20** may be permanently fixed to the rotor **12** or be removably attached thereto and have any cross-sectional area desired. For clarity, the canister **20** will be discussed as being removably attached to the rotor **12** and having a circular cross-sectional area defined by a cylindrical wall **26** that extends from a closed end **28**, terminating in an open end **30**. Protruding from the cylindrical wall **26**, between the closed end **28** and the open end **30**, is an annular shoulder **32**. Each of the bores **14** are shaped to receive the canister **20** so that the shoulder **32** rests against the rotor **12**.

Referring to FIGS. **1**, **3** and **4**, the capping assembly **24** includes a lid **34** having a cover portion **36** and a peripheral member **38**, surrounding the cover portion **36** and extending transverse thereto. The cover portion **36** has first and second opposed major sides **40** and **42**, respectively. The first side **40** has a convex shape, and the second side **42** has a concave shape. An upper portion **44** of the peripheral member **38** extends away from the second side **42**, terminating in an annular rim **46** positioned to face the first major side **40**. The upper portion **44** includes an inner **48** surface and an outer

surface **50**, disposed opposite to the inner surface **48**. The inner surface **48** extends between an upper surface of the annular rim **46** and the first side **40**. The outer surface **50** extends from the annular rim **46** toward the second major side **42**, terminating at an area of the peripheral member **38** that is positioned opposite to the cover portion **36**. The outer surface **50** has a frusto-conical shape and includes an annular recess **52** to receive a gasket, e.g. o-ring **54**. The annular rim **46** projects outwardly beyond the outer surface **50** and may be roughened or knurled to facilitate gripping the same. A lower portion **55** of the peripheral member **38** extends away from the upper portion **44**, terminating in an annulus **56** which faces the second major side **42**. The lower portion **55** includes inside and outside surfaces, **58** and **60**, respectively. The inside surface **58** extends between the second side **42** and the annulus **56**. The outside surface **60** is contiguous with the outer surface **50**, extending between the annular recess **52** and the annulus **56**. The lower portion **55** includes a plurality of threads **62** that are present on the inside surface **58**.

Referring to FIGS. **3** and **5**, a first set of arcuate ribs **64** extend across the first side **40**, following the contour thereof. Each of the ribs **64** traverse the extent of the cover portion **36** between opposed areas of the inner surface **48**. The ribs **64** of the first set intersect proximate to a center of the cover portion **36**, forming an apex **66** thereat. An annular contact ring **68** is disposed on the second major side **42** so as to be proximate to the inside surface **58** of the lower portion **55**. A second set of ribs **70** extend across the second side **42**, between opposed areas of the annular contact ring **68**. The second set of ribs **70** are arcuate in that they follow the contour of the second side **42** and intersect proximate to a center of the cover portion **36**, forming an apex **72** thereat. Each of the ribs **64** and **70** are adapted to flex, under a centrifugal load, expanding the peripheral member **38** outwardly, discussed more fully below.

Referring to FIGS. **1** and **4**, the receptacle **22** may be formed of any polymeric material which can be molded to include a tubular portion **74** extending from a threaded neck portion **76**, terminating in a closed nadir **78**. The inside diameter of the tubular portion **74** varies along the length thereof, providing the inside surface of the tubular portion **74** with a gradual taper. Specifically, the inside diameter of the tubular portion **74** is smallest proximate to the neck portion **76** and gradually increases so as to be largest proximate to the nadir **78**. This eases the removal of a sample therefrom by facilitating access thereto by a spatula (not shown) or other device. Compared to the remaining portions of the receptacle **22**, the neck portion **76** is provided with increased wall thickness, and therefore, increased strength, due to the gradual taper of the inside surface. The neck portion **76** includes a plurality of threads **80** and defines an open mouth **82**. The plurality of threads **62** are disposed on the inside surface **58** of the lower portion **54** and are adapted to engage the plurality of threads **80** of the neck portion **76**. In this fashion, the lid **34** threadably engages the receptacle **22**, with the second major side **42** being positioned adjacent to the neck portion **76** when placed in the final seating position. To obtain fluid-tight and air-tight integrity between the lid **34** and the receptacle **22**, a sealing device is disposed between the second side **42** and the neck portion **76**. Although any type of sealing device may be employed, e.g., an o-ring or other type of elastomer or plastomeric material, it is preferred that a stopper or plug **84** be employed, shown more clearly in FIG. **6**.

Referring to FIGS. **1** and **6**, the stopper **84** has a first major surface **86** and a second major surface **88**, disposed opposite to the first major surface **86**, as well as a peripheral surface **90** extending therebetween. An annular depending portion **92** extends from the second major surface **88**, away from said first major surface **86**. The depending portion **92** extends from an area of the second major surface **88** which is spaced-apart from the peripheral surface **90**, defining an annular flange **94**. An annular shoulder **96** is provided, between the annular flange **94** and the depending portion **92**, to receive a gasket **98**, such as an o-ring. To ensure that the gasket **98** is retained on the stopper **84**, an annular protrusion **99** is formed on the depending portion **92**.

Referring to FIGS. **1**, **2**, **7** and **8**, in operation, the depending portion **92** of the stopper **84** is placed into the mouth **82** of the receptacle **22**, and the lid **34** is threaded onto the neck portion **76**, with the receptacle fitted into the canister **20** so that the frusto-conical surface **50** is seated against the cylindrical wall **26**. To that end, the relative dimensions of the stopper **84** and the receptacle **22** are such that the depending portion **92** fits within the mouth **82**. In this fashion, the gasket **98** is wedged against the neck portion **76**, and the annular flange **94** approaches the upper edge **100** of the neck portion **76**. To allow the gasket **98** to conform with the shape of the shoulder **96**, while reducing the force necessitated to achieve the same, the neck portion **76** includes an arcuate gland **102**. The arcuate gland **102** is formed into the neck portion **76** to extend from the upper edge **100**, away from the plurality of threads **80**. The shape of the gland **102** produces a rolling action, when the gasket **98** is compressed. The rolling action reduces the amount of force necessitated to distort and squeeze the gasket **98** into the appropriate shape to form a fluid-tight and air-tight seal between the stopper **84** and the receptacle **22**. To facilitate the aforementioned compression, the annular contact ring **68** of the lid **34** is positioned to seat against the annular flange **94** of the stopper **84**, directly above the gasket **98**. The annular contact ring **68** is sized so as to extend toward the stopper **84** a further distance than the second set of ribs **72**. In this fashion, the second set of ribs **72** are spaced apart from the first major surface **86**, forming a void **106** therebetween.

As the rotor **12** rotates about its spin axis **16**, the centrifuge container **10** is subjected to a centrifugal load, operating thereon in a direction parallel to the axis **18**. The frusto-conical surface **50** allows the lid **34** and receptacle **22** to move toward the closed end **28** in response to the load, further tightening the seal between the gasket **54** and the cylindrical wall **26**. To facilitate this movement, the tubular portion **74** is in slidable engagement with the cylindrical wall **26**, and the nadir **78** is spaced-apart from the closed end **28**, when placed in the final seating position and the rotor **12** is at rest. The fluid-tight and air-tight seal formed between the gasket **54** and the cylindrical wall **26** prevents leakage of a sample or air from the canister **20**, were the receptacle **22** to rupture or otherwise allow the sample to egress therefrom. A further advantage provided by the lid **34** is that the ribs **64** and **70**, disposed thereon, amplify said force in response to centrifugal loading. Specifically, the ribs **64** and **70** are adapted to flex under centrifugal load, causing the apexes **66** and **72** to move toward the first major surface **86**. The movement of the apexes **66** and **72** expands the circumference of the upper portion **44** of the peripheral member **38**.

FIGS. **9** and **10** demonstrate the expansion of the circumference of the upper portion **44** of the peripheral member **38**. The static dimensions of the lid **34** are shown in FIG. **9**, when the rotor (not shown) is at rest, with the diameter of the peripheral member **38** being shown as D and the height of the apex **66** above the annular rim **46** shown as H. As shown

in FIG. **10**, during centrifugation, height of the apex **66** above the annular rim **46** changes as a result of the centrifugal load, discussed above, so as to measure a distance h, with h<H. The aforementioned change in height results from the deflection of ribs **64** and **70**. The deflection is in the range of 0.0010 to 0.0045 inch, depending upon the rotational speed of the rotor and the rotor's size. The aforementioned deflection causes a proportional change in the diameter of the peripheral member. As shown, under a centrifugal load, the diameter of the peripheral member **38** measures a distance d, with d>D. This results in an increase in the sealing force applied by the lid **34** that is proportional to the centrifugal load to which the lid **34** is subjected.

Referring again to FIG. **2**, **7** and **8**, the first and second sets of ribs **64** and **70**, however, provide a sufficient amount of resistance to the centrifugal load to maintain the void **106** between the second set of ribs **70** and the first major side **86**. This focuses the compressive force applied by the lid **34** onto the area of the stopper **84** which coincides with the annular ring **68**. It was discovered that compressive forces applied to the center of the stopper **84** caused the seal, formed between the gland **102** and the gasket **98**, to fail. Focusing the compressive force applied by the lid **34**, as discussed above, avoids this problem.

Referring to FIGS. **1** and **8**, to achieve a fluid-tight and air-tight seal between the gasket **98** and the gland **102**, the receptacle **22** includes a first alignment mark **108**, and the lid **34** includes a second alignment mark **110**. Both the first and second alignment marks **108** and **110** are arranged so as to be axially aligned after a predetermined amount of rotational movement between the lid **34** and the receptacle **22**. Although the alignment marks **108** and **110** may be indicia, in the preferred embodiment, the first alignment mark **108** consists of a recess formed into the tubular wall **74** so as to extend along a length thereof. In this design, the recess functions as a vent to allow fluid to move freely as the receptacle is being placed in, or removed from, the canister **20**. This prevents a vacuum, or positive pressure, from being present between the canister **20** and the receptacle **22**, thereby facilitating coupling and decoupling of the same. The second alignment mark **110** is typically a detent.

Referring to FIGS. **1**, **11** and **12**, additional features may be provided to facilitate coupling and decoupling of the various components of the dual vessel centrifuge container **10**. For example, the lid **34** may include curved handle **112**, the opposed ends of which are attached to one of the ribs **64** on opposing sides of the apex **66**. The opposed ends may include circular loops **114** having a gap **116** present therein. One of the ribs **64** may include through-ways **118** in which one of the circular loops **114** is disposed. This allows the handle **112** to be rotatably attached to the lid **34**, which facilitates placing the handle adjacent to the ribs **64** when not in use, shown in FIG. **11**. To further reduce the drag that the handle **112** may create during centrifugation, a slot **120** may be formed into each rib **64** so as to receive the handle when placed adjacent thereto. The slots **120** may be of sufficient depth to allow the handle **112** to be disposed between the apex **66** and the annular ring **46**. In addition, the flexibility of the ribs **64** and **70**, shown more clearly in FIGS. **3** and **4**, may be augmented by increasing either the number or the size of the slots **120**, present therein. Finally, as shown in FIGS. **6** and **7**, the stopper **84** may include a centrally located boss **122** having a threaded bore **124**. This allows a threaded removal device (not shown) to be employed to remove the stopper **84** from the receptacle **22**.

I claim:

1. A capping assembly for a centrifuge container, said assembly comprising:

a lid having a cover portion, a peripheral member, surrounding said cover portion and extending transverse thereto, and a plurality of ribs extending across said cover portion, with each of said plurality of ribs being coupled to opposed areas of said peripheral member and flexing, under centrifugal load, to expand said opposed areas outwardly away from a central region of said cover portion, thereby expanding said peripheral member.

2. The capping assembly as recited in claim **1** wherein said cover portion has first and second opposed major sides, said first side having a convex shape and said second side facing an opening and having a concave shape, with said plurality of ribs consisting of a first set of ribs disposed adjacent to, and following the contour of, said first major side, and a second set of ribs disposed adjacent to, and following the contour of, said second side.

3. The capping assembly as recited in claim **1** wherein said centrifuge container further includes a receptacle having an opening and a neck, surrounding said opening, with said neck including a plurality of threads and said lid including a threaded region engaging said plurality of threads so as to position said opening between said opposed areas and said threaded region.

4. The capping assembly as recited in claim **3** further including a sealing means, disposed proximate to said neck, for forming a fluid-tight and air-tight seal between said lid and said receptacle.

5. The capping assembly as recited in claim **4** wherein said sealing means includes a stopper having first and second opposed major surfaces and a depending portion extending from said second major surface away from said first major surface, with said depending portion fitting within said opening and form an interference fit with said neck.

6. The capping assembly as recited in claim **4** wherein said receptacle includes a first alignment mark and said lid includes a second alignment mark, with both said first and second alignment marks arranged so as to be axially aligned after a predetermined amount of rotational movement between threaded region and said neck so as subject said seal means to a preset load.

7. The capping assembly as recited in claim **6** wherein said receptacle includes a tubular portion extending from said neck portion and terminating in a nadir, with said first alignment mark consisting of a recess formed into said tubular wall so as to extend along a length thereof.

8. The capping assembly as recited in claim **3** wherein said peripheral member has upper and lower sections, said threaded region being disposed in said lower section, with a subset of said opposed areas being located in said upper section, said upper section having a frusto-conical surface disposed opposite to said opposed areas and further including a gasket disposed about said frusto-conical surface.

9. The capping assembly as recited in claim **3** wherein said centrifuge container further includes a canister having a closed end, an open end and a cylindrical wall extending therebetween, said canister receiving said receptacle therein, with said peripheral member seating proximate to said open end forming an interference fit with said cylindrical wall, whereby expansion of said peripheral member tightens the interference fit between said peripheral member and said cylindrical wall.

10. A capping assembly for a centrifuge container of the type including a receptacle and a canister, with said canister having a closed end and an open end with a cylindrical wall extending therebetween and said receptacle having an open-

ing and a neck, surrounding said opening, with said neck including a plurality of threads, said assembly comprising:

a lid having a circular cover portion, an annular peripheral member, surrounding said cover portion and extending transverse thereto, and a plurality of arcuate ribs extending across said cover portion, between opposed areas of said peripheral member, said peripheral member having a circumference and including a threaded region engaging said plurality of threads so as to position said opening between said opposed areas and said threaded region, with said lid seating proximate to said open end forming an interference fit with said cylindrical wall and each of said plurality of ribs flexing, under centrifugal load, so as to expand said opposed areas outwardly away from said plurality of threads, thereby increasing said circumference.

11. The capping assembly as recited in claim **10** further including a stopper having first and second opposed major surfaces, with an annular depending portion extending from said second major surface away from said first major surface, forming a shoulder therebetween, with an annular gasket disposed about said shoulder, said depending portion fitting within said opening, with said gasket resting against said neck.

12. The capping assembly as recited in claim **10** wherein said cover portion has first and second opposed major sides, each of which has an arcuate shape, with an annular contact area extending from said second side and positioned to bear against said stopper at a region disposed above said neck.

13. The capping assembly as recited in claim **12** wherein said plurality of ribs follow the contour of said first major side.

14. The capping assembly as recited in claim **13** wherein said peripheral member has upper and lower sections, with said threaded region disposed in said lower section and said opposed areas being located in said upper section, said upper section having a frusto-conical surface disposed opposite to said opposed areas and further including a gasket disposed about said frusto-conical surface.

15. The capping assembly as recited in claim **14** wherein said receptacle includes a first alignment mark and said lid includes a second alignment mark, with both said first and second alignment marks arranged so as to be axially aligned after a predetermined amount of rotational movement between threaded region and said neck so as subject said annular gasket to a preset load.

16. A capping assembly for a centrifuge container of the type including a receptacle and a canister, said canister having a closed end and an open end with a cylindrical wall extending therebetween and said receptacle having an opening and a neck, surrounding said opening, with said neck including a plurality of threads, said assembly comprising:

a lid having a cover portion, and an annular peripheral member including a sealing surface, said annular peripheral member fitting within said open end, with said sealing surface pressing said cylindrical wall with a predetermined amount of force, forming a fluid-tight and air-tight seal;

means, attached to said cover portion, for amplifying said force in response to centrifugal loading of said lid said amplifying means including a plurality of arcuate ribs.

17. The capping assembly as recited in claim **16** wherein said receptacle includes a tubular portion extending from said neck portion and terminating in a nadir, with said sealing surface having a frusto-conical shape and said amplifying means including a gasket disposed about said frusto-conical surface.

18. The capping assembly as recited in claim **17** wherein said ribs extend across said cover portion, between opposed areas of said peripheral member, with each of said plurality of ribs flexing, under centrifugal load, to expand said opposed areas outwardly against said cylindrical wall.

19. The capping assembly as recited in claim **18** further including a stopper having first and second opposed major surfaces, with an annular depending portion extending from said second major surface away from said first major surface, forming a shoulder therebetween, with an annular gasket disposed about said shoulder, said depending portion fitting within said opening and said gasket resting against said neck.

20. The capping assembly as recited in claim **19** wherein said cover portion has first and second opposed major sides, said second side having a concave shape and facing said opening, with an annular contact area extending from said second side and positioned to bear against said stopper at a region disposed above said neck, with a remaining portion of said second major side being spaced apart from said first major surface.

* * * * *